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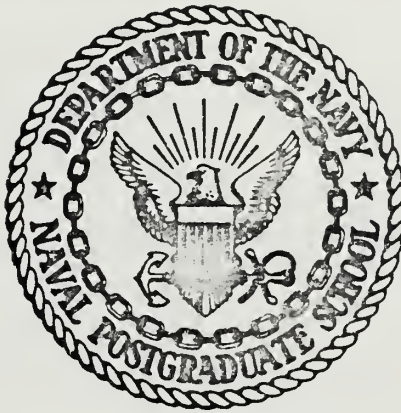
A STUDY OF NAVAL ADMINISTRATIVE
TELEPHONE SYSTEM MANAGEMENT

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THESIS

A STUDY OF NAVAL ADMINISTRATIVE
TELEPHONE SYSTEM MANAGEMENT

by

Joseph Henry Steele III

March 1975

Thesis Advisor:

P. E. Cooper

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A Study of Naval Administrative
Telephone System Management

by

Joseph Henry Steele III
Lieutenant Commander, United States Navy
B.A., University of Delaware, 1965

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the
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March 1975

ABSTRACT

This thesis is a study of Naval administrative telephone management organization and practices. The model used in the study is the Naval Postgraduate School, Monterey, California. The current management organization, both local and national, is discussed. A proposal for future organizational relationships at the Naval Postgraduate School to deal with telephone systems as a part of Naval telecommunications is presented. The various components of a telephone system are described. System management practices are explored in depth to include system planning, standards, cost factors, and methods of evaluation. Particular emphasis is given to toll call and inventory procedures. A basic doctrine for system guidelines and standards is developed along with a format for a computerized local equipment inventory listing. The overall conclusion is that Naval administrative telephones are not being managed as a system. Specific recommendations for management improvement are offered.

TABLE OF CONTENTS

I.	INTRODUCTION -----	9
II.	SYSTEM DESCRIPTION-----	11
	A. CENTREX-----	11
	B. KEY SYSTEMS-----	13
	C. AUTOVON-----	14
	D. FTS-----	15
	E. WATS-----	16
	F. FX-----	16
	G. TELPAK-----	17
III.	MANAGEMENT ORGANIZATION-----	18
	A. CURRENT ORGANIZATION-----	18
	1. General-----	18
	2. National Level-----	19
	3. Regional Level-----	22
	4. Local Level-----	26
	B. FUTURE ORGANIZATION-----	29
	C. REMARKS-----	34
IV.	SYSTEMS MANAGEMENT-----	37
	A. SYSTEM PLANNING-----	37
	1. General-----	37
	2. Service Requirements-----	39
	3. Types and Classes of Telephone Service	48
	4. Changes in Service-----	51
	5. Telephone System Cost Factors-----	53

a. Equipment and Service Costs-----	54
b. Management Costs-----	56
B. SYSTEM EVALUATION-----	57
C. COST CONSIDERATIONS-----	60
1. Monthly Service Charge-----	61
2. Toll Charges-----	72
3. Local Calls-----	77
4. Installation/Connection Charges-----	78
D. REMARKS-----	80
V. INVENTORY CONTROL-----	83
A. INVENTORY REQUIREMENTS-----	83
B. REMARKS-----	85
VI. TOLL CALL MANAGEMENT-----	91
A. CLERICAL PROCEDURES-----	91
B. CONTROL PROCEDURES-----	94
C. REMARKS-----	96
VII. CONCLUSION-----	100
APPENDIX A. Glossary-----	103
APPENDIX B. Proposal for the Future Telephone Management Organization at the Naval Postgraduate School-----	106
APPENDIX C. Standards and Guidelines for Local Administrative Telephone Management---	110
APPENDIX D. Computer Program for Telephone Equipment Inventory-----	129
BIBLIOGRAPHY-----	145
INITIAL DISTRIBUTION LIST-----	147

9

LIST OF FIGURES

1.	Naval Telephone Management Organization.	20
2.	Naval Postgraduate School Public Works Department Telephone Management Organization	29
3.	Work Process in System Planning.	38
4.	NPGS Telephone Costs	62
5.	Graph of Main Station NPGS Service Charges	63
6.	Graph of Total Service Charges	64
7.	Graph of Main Station Toll Charges	65
8.	Graph of Total Toll Charges.	66
9.	Graph of Total Other Charges and Credits	67
10.	Graph of Total Telephone Charges	68
11.	Telephone Management Organization.	109

LIST OF EXHIBITS

1.	"Required Information for Changes in Telephone Services" (pp. 9-10, <u>Management of Communications Services</u> , TCS P 7100.2A)	44
2.	"Traffic Engineering Survey Summary" (pp. 11-12, <u>Management of Communications Services</u> , TCS P 7100.2A)	45
3.	"Factors to be Considered in Determining Type and Size of Switchboard". (pp. 13-14, <u>Management of Communications Services</u> , TCS P 7100.2A)	47
4.	"Distribution of Toll Call Times" (p. 33, <u>Navy Telephone System Study - Metropolitan Area Configuration</u>)	73
5.	Extract from Pacific Telephone "Green Sheets" for NPGS.	88
6.	Toll Call Certification Form.	92
7.	Toll Call Record (NAVSO FORM 2305/2).	98

I. INTRODUCTION

This thesis is a study of Naval administrative telephone systems with respect to management organization and policy. Administrative telephone systems can be described as those systems designed to support base complexes and to interface with other telecommunications networks as opposed to strictly command and control telephone networks.

The model system used for the study is the Naval Postgraduate School, Monterey, California. Although the model does not represent all naval shore activities in size, configuration, or complexity, the management principles applied are considered representative of Navy-wide procedures. The study deals with the commercial aspects of the system. Supplementary services provided by the Department of Defense and General Services Administration interfaces (AUTOVON and FTS respectively) are included only where they impact on the managerial aspects of the commercial system.

The premise on which the thesis is based is that Naval administrative telephone systems should be incorporated into and managed as a part of Department of Defense telecommunications networks. In order to accomplish this objective, base telephone installations must first be organized and managed as a system within themselves. In this light, current local activity telephone management practices and policies are examined. Primary emphasis is placed on management organization, system planning, evaluation, cost

factors, physical inventory control, and toll call management. Various methods for the determination of requirements, alternatives for satisfying those requirements, evaluation techniques, and administrative control procedures are discussed. Recommendations for organizational and managerial improvements leading to a more centralized, responsive, and cost-effective telephone system are introduced. A management doctrine to serve as a basic guideline for Naval activity administrative telephone management is developed. Also, in Appendix B, a possible organization for NPGS is provided that is consistent with the proposed reorganization for the management of Navy telephone systems.

Methods of research included an extensive review of current telephone management directives and policies and involved interviews with numerous managerial and administrative personnel at the Naval Postgraduate School. These policies and opinions were combined with the author's observations of the managerial process of telephone administration at the NPGS to reach the conclusions presented in this thesis.

II. SYSTEM DESCRIPTION

The model for this study, the administrative telephone system at the Naval Postgraduate School, is operated and managed as a utility service by the local Bell System telephone company. The service provided is a Central Exchange (CENTRIX I) located at the school with multiple key systems and numerous peripheral circuits and facilities.

As is the case with the vast majority of Naval activities, all equipment and lines are leased from the local telephone company under a Basic Termination Contract. A monthly bill is provided which includes equipment service charges and toll charges. Support services such as building space, electrical power, heat and lighting, on-base conduits, and operating personnel are provided by the facility. Lines and their support facilities, and poles or conduits to off-base activities are telephone company owned and maintained. Installation, removal, modification, and maintenance of all equipment is conducted by the telephone company under the terms of the basic contract.

A. CENTREX

Central Exchange, or CENTREX I, is a system that provides separate switching equipment from that at the telephone company's central office for all telephones connected to the system. There are numerous possible configurations of CENTREX I depending upon the subscriber needs, budget restrictions, and specific assets of the serving telephone

company's central office. In addition to the great flexibility available with CENTREX I, a means for common integrated billing for all services used by the subscriber is provided.

The CENTREX I system allows for a large number of possible on-site lines while requiring a considerably smaller number of trunks between the activity and the central office. The CENTREX I installed at NPGS provides a 900 line and 80 trunk capability. All incoming calls with a specifically assigned prefix are directed to the NPGS Central Exchange. Outgoing calls are directed by the CENTREX to a central office trunk and then handled just as a call from any individual number. Intra-base service is provided by the CENTREX by dialing only the unique four-digit line number.

Additional ancillary functions are available in the CENTREX I:

1. Line finding, or "rotary hunt", which causes an incoming call to be automatically transferred to the next higher number when a busy line is encountered. This feature must be pre-set in the exchange equipment for the groups of lines involved.

2. Manual switchboard services performed by an operator for conference connections, manual transfer of calls, information service, and AUTOVON access for lines not so equipped.

A "line" is an individual telephone number. The line may be connected to either a basic single telephone

instrument, with or without extensions, or a key system. The term "straight line" is used when the line is not subconnected into a key system.

A "telephone" or "station" is a single instrument which may be a simple desk set, a one-button desk set, a six-button desk set, a wall phone, or a multi-button Call Director.

B. KEY SYSTEMS

The Service and Equipment Guide published by the Pacific Telephone Company describes a key telephone system as:

"...consisting of one or more key telephone stations, and may include non-key stations, furnished to the same customer where:

1. All stations are located in the same building, or in separate buildings on the customer's continuous property within 300 feet route measurement, from the associated relay equipment, and;
2. Includes all stations interconnected to other stations by means of one or more of the same customer's lines including extension station lines or by interconnecting stations."

Key stations consist of telephone sets with internal key buttons or non-key stations with or without a single separately mounted key button unit. Key stations may be of the one-button, six-button, or multi-button Call Director variety. These are designated as COMPAK I, COMPAK II, and COMPAK III or IV respectively by the telephone company. Key station sets are provided at an additional monthly service charge. Features may be provided within the key system at further additional cost including:

1. Various manual and dial intercommunicating arrangements with associated internal or external signaling equipment such as buzzers and lights.
2. Lighted indication of lines being used or held.
3. Cutoff or hold feature.
4. Selective or automatic exclusion for individual line privacy.
5. Switch of lines on unattended telephones to an attended telephone.

In a large organization with a CENTREX capability, key systems are primarily used to complement the Central Exchange or to provide greater flexibility and convenience. Most key telephone stations consist of six-button telephones with occasional use of Call Directors.

C. AUTOVON

The Automatic Voice Network (AUTOVON) is a Department of Defense system of leased facilities linking DOD installations worldwide. As described in OPNAV Instruction 2305.13, AUTOVON is:

"...the principal long distance nonsecure voice network of the DOD. AUTOVON will be used only for official communication and service will be provided only to the most essential elements of commands that require long distance telephone communication in support of command, operation, intelligence, logistics, diplomatic matters, and administration."

It is operated and maintained by the military departments under the operational direction and management control of the Director, Defense Communications Agency (DCA). The

AUTOVON network interconnects the official on-base telephone systems of the Department of the Navy, thus making them an extension of the worldwide DOD voice communications network.

Typically, a number of AUTOVON lines terminate at a Naval activity's Central Exchange. These lines are subdivided into incoming and outgoing access categories in accordance with the requirements of the activity. At the NPGS CENTREX, eleven lines are terminated with seven accessible for incoming or outgoing calls and four for incoming calls only. Any line associated with the CENTREX may be provided AUTOVON access at the discretion of the local command. The only additional cost involved is a connection charge levied by the telephone company.

D. FTS

The Federal Telecommunications System (FTS), established and managed by the General Services Administration, provides a fast, efficient method for the transmission of all types of record and voice communications nationwide for the Federal agencies. The FTS consists of two fundamental operating networks, the intercity voice network and the Advanced Record System. GSA operates consolidated telephone switchboards and Federal Telecommunications Record Centers provide local terminal facilities as communication services to government activities in major cities of the United States. The FTS, with associated consolidated switchboards, is available to any organizational unit of the Federal Government and,

under prescribed conditions, to state and local governments and Federal Government grantees.

E. WATS

Wide Area Telecommunications Service (WATS) is a form of commercial long-distance telephone service available within the continental United States. A WATS line allows a user to dial out to or receive calls from (but not both) a designated geographic territory without incurring a specific charge per call. This territory varies with the user's location. In order to provide for both IN-WATS and OUT-WATS, separate lines must be ordered. WATS permits unlimited interstate calling at a flat monthly rate from the base telephone exchange to commercial telephones within the specified zones. WATS offers a choice of full-time service without interruptions, an unlimited number of separate calls during a 24-hour period, or measured time service that permits unlimited calls during 15 consecutive hours or cumulatively during 15 separate hours each month. Intrastate bands are also available at a flat or measured rate.

F. FX

Foreign Exchange (FX) is an alternative to direct distance dialing (DDD) providing trunk connection to nearby but non-local areas. This service is provided by the local telephone company at a flat monthly rate for a message allowance of 200, with an additional charge per message over the allowance, plus mileage charges.

G. TELPAK

TELPAK is a service offered by the telephone companies which can provide a wideband channel or a bundle of lesser channels. The TELPAK channels serve two purposes. First, they provide a wideband channel over which data can be sent at a much higher rate than over a single voice channel. Second, they provide a means of offering groups of voice or sub-voice grade lines at reduced rates. Originally, there were four sizes of TELPAK channels: TELPAK A, B, C, and D. In 1967 the TELPAK A and B offerings were eliminated due to discriminatory rates.

TELPAK C (Type 5700 line) has a base capacity of 60 voice channels. TELPAK D (Type 5800 line) has a base capacity of 240 voice channels. Each voice channel in these lines can be further subdivided into specific use, sub-voice grade channels.

The TELPAK customer pays a monthly charge based on the capacity of the channel he selects, the number of air-distance miles between locations, and the type and quantity of channel terminals. He has use of this channel on a full-time basis.

III. MANAGEMENT ORGANIZATION

A. CURRENT ORGANIZATION

1. General

The landline communication facilities and services, including those of commercial communication services, available to meet the Naval establishment's requirements are administered by the Chief of Naval Operations under OPNAV Instruction 2300.4A. This instruction states that the establishment of communications requirements and the operational and administrative responsibility for rendering maintenance to facilities provided is a function of command.

Within the shore establishment, the administration of telephone communications has a dual nature. As an instrumentality of communications, the telephone serves, and is administered, by command. From the viewpoint of business administration, the telephone is a utility. When the telephone is considered an instrumentality of communications serving command, command responsibilities outlined in OPNAV Instruction 2300.4A will be discharged by each commander. When the telephone is considered a utility, the procedures for telephone system maintenance, procurement, and detailed business administration shall be those applicable to other utilities in conformance with existing directives and under the technical control of the Headquarters, Naval Facilities Engineering Command, or the Commandant of the Marine Corps (CMC).

Telephone service is separated into two types: local and local integrated. Either type of service provided may be leased or government-owned or a combination thereof.

Local telephone service is that which is provided through a leased or government-owned telephone plant to a single activity or several activities for which a single office has management control. Local telephone service for a group of activities for which a single office has financial responsibility will be supported by appropriations controlled by the office concerned in accordance with its instructions.

Local integrated (multi-user switchboard) telephone service is that provided by a common local telephone system serving a number of activities or departments thereof for which different offices have management control or financial responsibility.

Figure 1 graphically illustrates the current dual telephone management organization from the activity level up through the Chief of Naval Operations (CNO).

2. National Level

Commander, Naval Telecommunications Command (COMNAV-TELCOM), is assigned as the executive agent for the Chief of Naval Operations for all naval shore communications, and as such has overall command responsibilities for telephone systems.

Commander, Naval Facilities Engineering Command (COMNAVFACENGCOM), and his designated representatives are

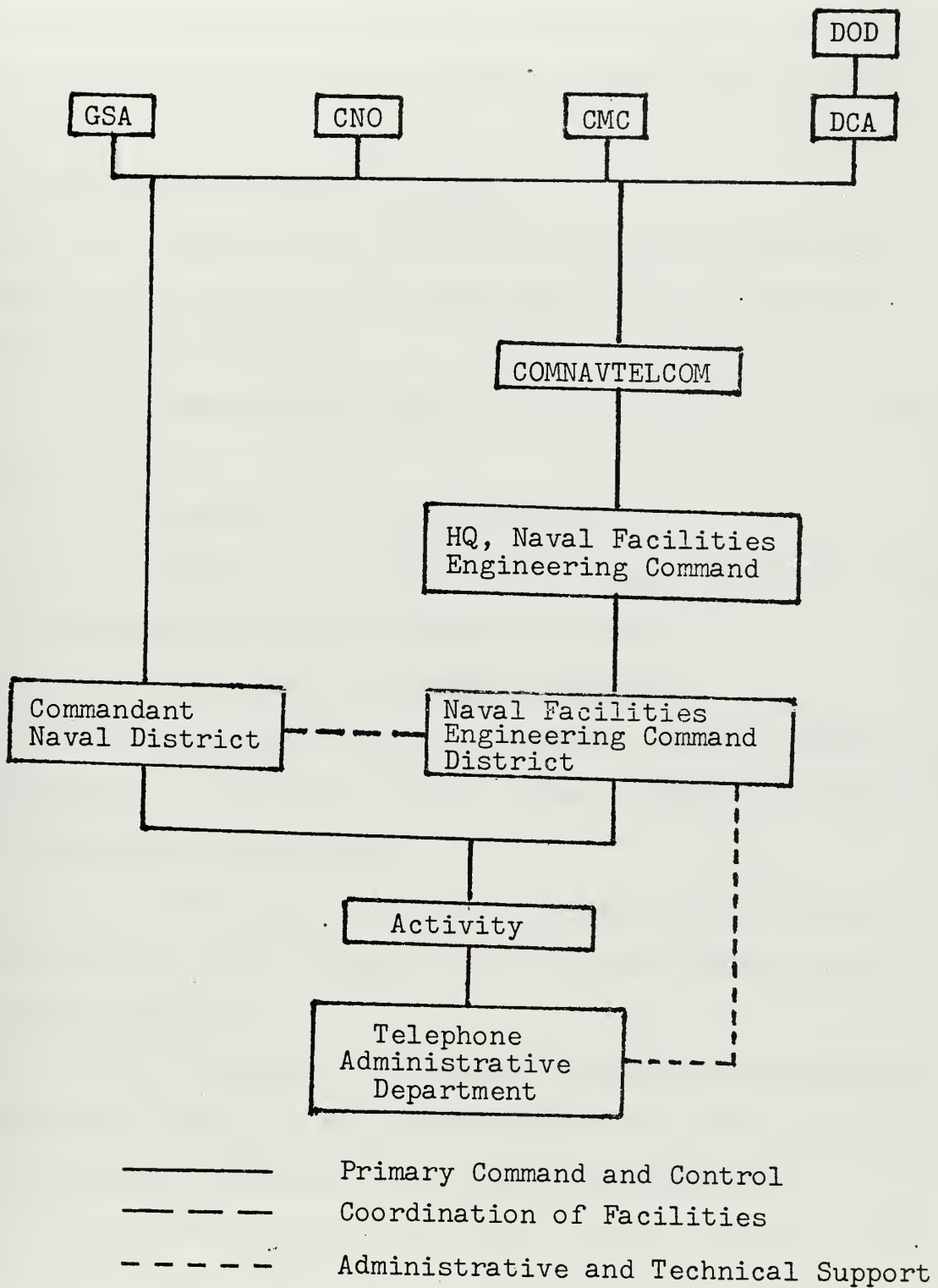


Figure 1. Naval Telephone Management Organization

assigned responsibilities as the logistic agent and business administrator for telephone service. These responsibilities include:

For leased telephone systems--

1. Prepare and execute contracts with commercial communication companies as appropriate for all landline communication services;
2. Place orders under such contracts for local telephone service;
3. Provide technical assistance;
4. Ensure the accuracy of invoices for local service;

For government-owned telephone systems--

5. The technical aspects of design;
6. The installation, alteration, general repair, and maintenance of telephone systems owned in whole or in part by the Department of the Navy;
7. The logistic business administration details of such systems unless delegated to the local operating activity or other command.

The Commandant of the Marine Corps exercises those appropriate foregoing responsibilities for activities under his management control and financial responsibility.

Uniform contracts have been jointly executed by the three military branches of the Department of Defense with all affiliates of American Telephone and Telegraph Company or other telephone companies as applicable for local telephone

services and by the Defense Communications Agency (DCA) with the telephone companies for long lines services.

The Department of Defense, through the DCA, has direct responsibility for the AUTOVON and AUTODIN (Automatic Digital Network) systems. Overall management control for these systems is therefore exercised by the DCA where local telephone systems interface with the AUTOVON/AUTODIN networks for either voice or record telecommunications.

The General Services Administration (GSA) through its Automatic Data and Telecommunications Service (ADTS) operates the Federal Telecommunications System. Where local telephone systems interface with the FTS, management control of the FTS portion is exercised by the GSA.

3. Regional Level

District Commandants and activity Commanding Officers are designated by OPNAV Instruction 2300.4A to exercise command functions depending upon the type of service involved. In the case of local telephone service, that provided by a local telephone system to a single activity or several activities under the management control or financial responsibility of a common office, the Commanding Officer of one activity will be designated by the Commandant, or Area Commander concerned, as the responsible command for the operation and administration of the service. If, in accordance with current instructions, a requested change of service is one which the Commanding Officer is authorized to approve, correspondence

relative to the change is to be channeled to COMNAVFACECOM or his designated representative. Requests for changes in service which the Commanding Officer is not authorized to approve will be forwarded to the Commandant or Area Commander for appropriate action.

Under the local integrated telephone service situation where a number of activities are served by a common local telephone system for which different offices have management control or financial responsibility, command functions rest with the District Commandant or Area Commander. He is responsible for administration and control of integrated local telephone systems and will execute the command responsibilities previously outlined. He is charged with the coordination and determination of each activity's prorata share of the overall local service expense for integrated systems, and for ensuring that the operation and administration of the system is in accordance with current directives.

Typically, as exemplified by COMELEVEN Instruction 2305.1, the District Commandant is responsible for determining military characteristics, adequacy, ownership, operation, and usage of systems and for reviewing and/or approving switchboard systems, including general engineering considerations such as size, dial or manual operation, number of operating positions, location of equipment and similar features plus the administration and control of local integrated telephone services. The District Commandant's primary involvement is

in the coordination of services and facilities within the district, not in administering details of individual command's requirements for service.

At this regional level, NAVFAC's agents are the Engineering Field Divisions (EFD). The EFDs are responsible for negotiating and executing contracts with commercial communications companies, placing orders under such contracts for telephone service after requirements have been determined and required approval has been obtained, providing technical assistance, and ensuring the accuracy of invoices for systems leased by the DOD. Additionally, they shall be responsible for the technical aspects of design, installation, alteration, general repair, and maintenance and logistic administration details of systems owned by the DOD.

Specifically, in accordance with NAVFAC P-68, Contract Administration Manual, and pursuant to the Navy Procurement Manual and the Armed Services Procurement Regulations, the Commander, NAVFACENGCOMD has been delegated authority to execute on behalf of the Department of the Navy (including the Marine Corps) all contracts for telephone communication facilities and services required by the Department of the Navy.

The EFD Commander is delegated the authority to negotiate, prepare, and execute orders for local telephone communications facilities and services within his region of authority. Within the EFD, the head of the Commercial Utilities Branch is delegated the authority to sign orders for local telephone service.

The EFD may delegate its authority to order minor changes to Commanding Officers of major activities remotely located. This delegation of authority to the local COs is made on an annual basis, without dollar limitation, by issuing a notice to the local telephone service contractor.

For all services exceeding those delegated, new installations, or major rearrangements where the aggregate value is one thousand dollars or more, the EFD must make a finding that the service to be procured is engineered in a manner to provide the service in the most efficient and economical basis, consistent with the purpose and mission of the activity. The EFD is authorized to place orders for work where the estimated cost does not exceed \$1999 on a negotiated basis. For work in excess of \$2000, such services should be procured by competitive bidding. When the cost exceeds that value and competition is not practicable, the EFD must forward the request to NAVFAC showing the estimated cost of the work, reasons that bidding is impracticable, and justification for the work's performance. When approval as to the operational and military needs by higher authority is required, the EFD must provide with the request the contractor's recommendation, its own independent engineering and technical study, cost of the requested service, and differences, if any, between these recommendations.

The EFD is also responsible for maintaining a complete current inventory of all equipment installed. Additionally,

the EFD must conduct an annual review of invoices including such items as determination of application of the telephone company's most favorable rate, credit for outages, accurate billing, and agreement between inventory and billing. In most cases, the inventory control and review functions are delegated to the local activity.

4. Local Level

The Commanding Officer of each activity is responsible for the telephone service at the activity. However, he delegates responsibility for management and execution of this function to lower echelons within the command. Different in-house organizations may handle this function within different activities, depending upon the structure of each activity. Typical organizations holding the function are: (1) communications office, (2) administrative department, (3) facilities management division, (4) telephone branch, and (5) public works department. In most cases, the individuals responsible are civilian, but frequently the staff is augmented with military personnel, and the department head may be a military officer.

Functions performed by the telephone administrative organization within the local command include requirements determination, facilities planning, financial accounting, telephone directory preparation and distribution, and operator administration.

The delegation of authority to activity personnel to sign Communication Service Authorizations (CSA), which are utilized when ordering or changing telephone service, is typically as follows:

a. The delegation is limited to station installations, changes of location of stations, station extensions, wiring plans, key systems with stations that will accommodate up to six pickups, and other basic equipment furnished by the telephone company and billed in accordance with legally established tariffs. Disconnection of any service may be authorized provided no termination liability is incurred.

b. The delegation does not include central office switching equipment expansions or special or auxiliary equipment such as: touch-tone instruments, unless provided without additional cost; call directors, speed dialer, or card dialers; speaker phones, etc. All changes, modifications, and expansions of central office switching equipment and all new construction requirements must be submitted for approval via the EFD.

The EFD provides, on an on-request basis, consulting service relating to design, installation, alteration, general repair, and maintenance of telephone facilities.

The primary source of information concerning telephone services at the local command level, and often the sole advisor and consultant utilized, is the telephone company Marketing Representative. For other than simple additions,

relocations, or removals, he proposes the equipment and features to fulfill a request for service.

In the model used for this study, the managerial functions for telephone administration are performed by the Public Works Department (PWD). This assignment is typical of most Naval activities due to the relationship between the PWD and EFD. The PWD carries out the functions of requirements determination, facilities planning, financial accounting, directory preparation and distribution, and telephone operator administration. The specific organizational relationships are presented in Figure 2.

The duties and responsibilities of department personnel involved in telephone management are described below:

- a. Public Works Officer - is responsible to the Director of Military Operations and Logistics for the organization, administration, and supervision of the Public Works Department. He is responsible for all facilities, including utilities. In performing these duties, he is guided by technical standards provided by NAVFAC.

- b. Assistant Public Works Officer - serves as Telephone Officer and, as such, supervises managerial functions associated with the installed telephone systems. He keeps necessary records of all official and unofficial telephone services, checks and certifies monthly telephone bills for official services, affects collections for unofficial telephone services, and reviews change requests (CSAs) for approval.

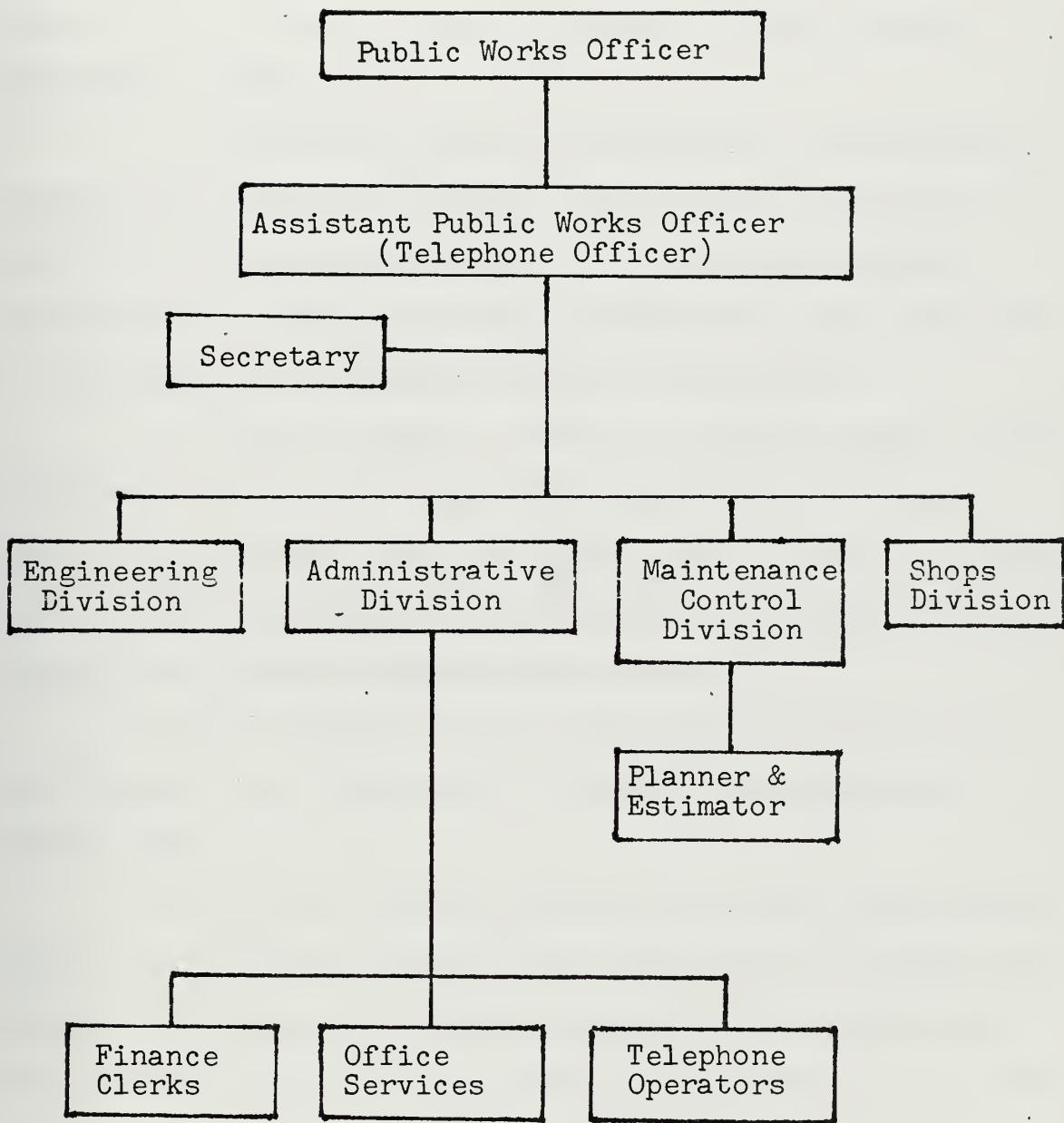


Figure 2. Naval Postgraduate School Public Works Department Telephone Management Organization

c. Administrative Division Officer - supervises the day-to-day administration and financial accounting functions as directed by the Telephone Officer. In addition to the Public Works Officer and the Telephone Officer, he has authority to sign CSAs.

d. Electrical Planner and Estimator - reviews and prepares CSAs based on requests for services or changes in physical layout or organization. He maintains complete records of the telephone system configuration and serves as a coordinator for telephone facilities planning.

e. Finance Clerks - receive telephone company bills, separate toll calls by responsible department or tenant activity and provide listings of the same for their verification, prepare billings for reimbursable costs, type CSAs and reports, and maintain appropriate records.

Specific details of the authority delegated to the local command are contained in official EFD letters and in NAVFAC P-68.

Of the above listed personnel, only the Public Works Officer and Assistant Public Works Officer are military personnel (officers), the remainder being civilian employees. The experience and knowledge levels of the key personnel vary greatly.

B. FUTURE ORGANIZATION

Since the mid-1950s, the general administration of Department of the Navy telephone systems has been of a dual

nature. As an instrument of communications, the telephone has served and has been administered by command. From the viewpoint of business administration, the telephone has been a utility, similar to other facilities such as light, heat, and water systems.

The Congress has made known its desire for improved management practices and better visibility of the true funding of communications operations. It has requested that the Department of Defense include all funds for specific operations within the same budget activity and that all communications costs, both telephones and telecommunications, be included in the Defense request for communications funds [Hynes, 1973].

DOD Instruction 7045.12, the Five Year Defense Program Telecommunications Subsystem, 24 February 1972, requires the military departments to develop a capability to support the Defense FYDP Telecommunication Subsystem. The DOD Consolidated Telecommunications Program, a primary output of this Subsystem, includes in the definition of base communications on-base telephone and related telecommunications systems and resources. Resources at a telecommunications center that support a base complex are described as: base telephones, industrial security networks, crash networks, paging networks, walkie-talkies, two-way radios, internal communications, etc. Resources include the necessary manpower to support base communications whose primary function is to manage, operate, and maintain these telecommunications systems [Hynes, 1973].

Unlike the Department of the Navy, the Secretaries of Defense, Army, and Air Force and the Director, Defense Communications Agency, operate and manage official telephone systems as telecommunications systems. This difference in management philosophy is not consistent with DON telecommunications programs for end-to-end network operations in relation to the other services.

To foster uniform management of Defense telecommunications and to improve responsiveness to telecommunications policies and procedures, the Department of the Navy is currently planning realignment of its telephone systems and services to the end that they shall be designated and managed as telecommunications systems and be operated and maintained as a function of the telecommunications centers supporting base complexes.

The existing policy of managing telephones as utilities has the advantage in that procedures for improvement, maintenance, and operation are provided by the same organization that is responsible for material support, namely NAVFAC. This policy, however, has numerous disadvantages. Because of its inherent duality, there exists fragmentation of operations and support responsibilities and thus fragmentation of responsibility for end-to-end telecommunications resource management. Within the present organization there is divided responsibility for the telephone system (utility) and the AUTOVON system (telecommunications). This fact

tends to perpetuate management which is at odds with DCA policy for end-to-end telecommunications systems.

Under the proposed organizational and functional realignment, Department of the Navy official telephone systems will be operated and managed as voice telecommunications systems, elements of the defense-wide voice communications system network, assuring effective voice communications service for Naval subscribers afloat and ashore. Official telephone systems, both leased and Navy/government owned, will be configured, engineered, operated, maintained, and supported in a manner which will make them operationally and technically compatible with the AUTOVON network of the Defense Communications Agency.

At those base complexes where the telecommunications center is operated by an activity other than the one operating the telephone system, the telephone system functions and resources will be transferred to the activity operating the telecommunications center as a function thereof.

The Commander, Naval Telecommunications Command, will act for the CNO as control coordinator with respect to the operations and maintenance management of official telephone systems and services and will provide for the general administration of these services and systems and related telephone matters of the Navy as a function of telecommunications management. He will be responsible for initiating leases for all commercial telephone systems and services of the Navy through the issuance

of Communications Service Authorizations and will budget for and administer funds as the major claimant for commercial telephone systems and services of the Navy on a Navy-wide basis. These functions, as previously stated, are now the responsibility of COMNAVFACENGCOM.

The Chief of Naval Material, through COMNAVFACENGCOM, will continue to provide effective material support, conduct communications engineering analyses, and provide advice, as required, regarding the leasing of telephone systems and issuance of CSAs.

Shore activities will realign their organizations in accordance with the above-stated policy and will operate and maintain telephone systems and services as a function of the telecommunications centers that support base complexes.

Appendix B to this thesis presents a possible organizational structure in support of this realignment policy for the Naval Postgraduate School, Monterey, California. The NPGS represents a situation where the telephone system and the telecommunications center are managed by separate activities. This organizational separation is typical of Navy-wide practice at the present time.

C. REMARKS

Management of telephone services at the user level, the local command level, is essentially a ministerial operation. The day-to-day supervision, procurement, staffing, and monitoring of telephone services and switchboard operations is

being conscientiously supported and performed by the Naval activities and the serving telephone companies. Intervention by higher authority in the routine operations is minimal, and then only in a negative sense such as when it questions the requests for expensive equipment or specialized circuits and trunks. Despite the fragmentation and duality of command relationships, the telephone systems work well within the framework for which they have been established.

However, when viewed with respect to the explicitly expressed policy of the CNO, as stated in OPNAV Instruction 2300.4A, to provide the most feasible and economical use of the telephone services and facilities of commercial communications companies where such services are reasonable and adequately available, the management function is significantly deficient. Kerr, in his study of the San Diego Naval complex, has stated that "what is missing in the management structure is the ability to deal with telephone communications as a system. Nowhere ... is there an assigned capability to study, configure, or revise telephone key systems. Nowhere is there the responsibility to deal with the tradeoff studies and configurations or to determine the interactions of voice and data or voice and message traffic. Nowhere is there the incentive to transcend the requirements of individual facilities and examine the feasibility and economics of shared circuits or systems or to provide a single responsible contact point to negotiate matters of interest to all of the facilities with the local communications companies." [Kerr, 1973].

Kerr further points out that "management of the telephone system is fragmented and geared, for the most part, to daily operations (manning switchboards, expediting changes, reporting outages, filling outages, filling out administrative reports, etc.)."

Within the telephone management organization, be it a large consolidated area or a single isolated activity, the primary need is for a central telephone coordinator with both designated responsibility and authority. He would serve as a focal point for all management functions relating to the planning, evaluation, control, and administration of the installed telephone system. For reasons of continuity, experience, and knowledge, this individual should be a civilian and should report to the highest appropriate military officer (department head) for the performance of his assigned responsibilities. Included in Appendix B are the proposed duties and the organizational relationships for the Telephone Coordinator in line with the anticipated realignment of the telephone management functions.

IV. SYSTEMS MANAGEMENT

A. SYSTEM PLANNING

1. General

Systems planning essentially is the process of generating and evaluating alternative ways of designing or changing a system in some beneficial manner. The prime considerations in system planning encompass cost reduction, competitive forces, and technological advances. The sum total of these considerations produces both the need and the means for change [Rudwick, 1969].

Inherent in the systems planning process is systems analysis. The RAND Corporation defines systems analysis as:

"an inquiry to aid a decision-maker choose a course of action by systematically investigating his proper objectives, comparing quantitatively where possible the cost effectiveness, and risks associated with alternative policies or strategies for achieving them, and formulating additional alternatives if those examined are found wanting."

The systems planner starts with a need and develops a preferred solution from among several alternatives developed, whereas the systems analyst starts with the preferred solution and other alternatives developed and investigates whether the recommended preferred solution does indeed offer the best approach, including the possibility of uncovering other approaches during the evaluation process.

A simplified model of the systems planning work process is shown in Figure 3 [Rudwick, 1969]. The first element in the process is the requirement to define the mission which

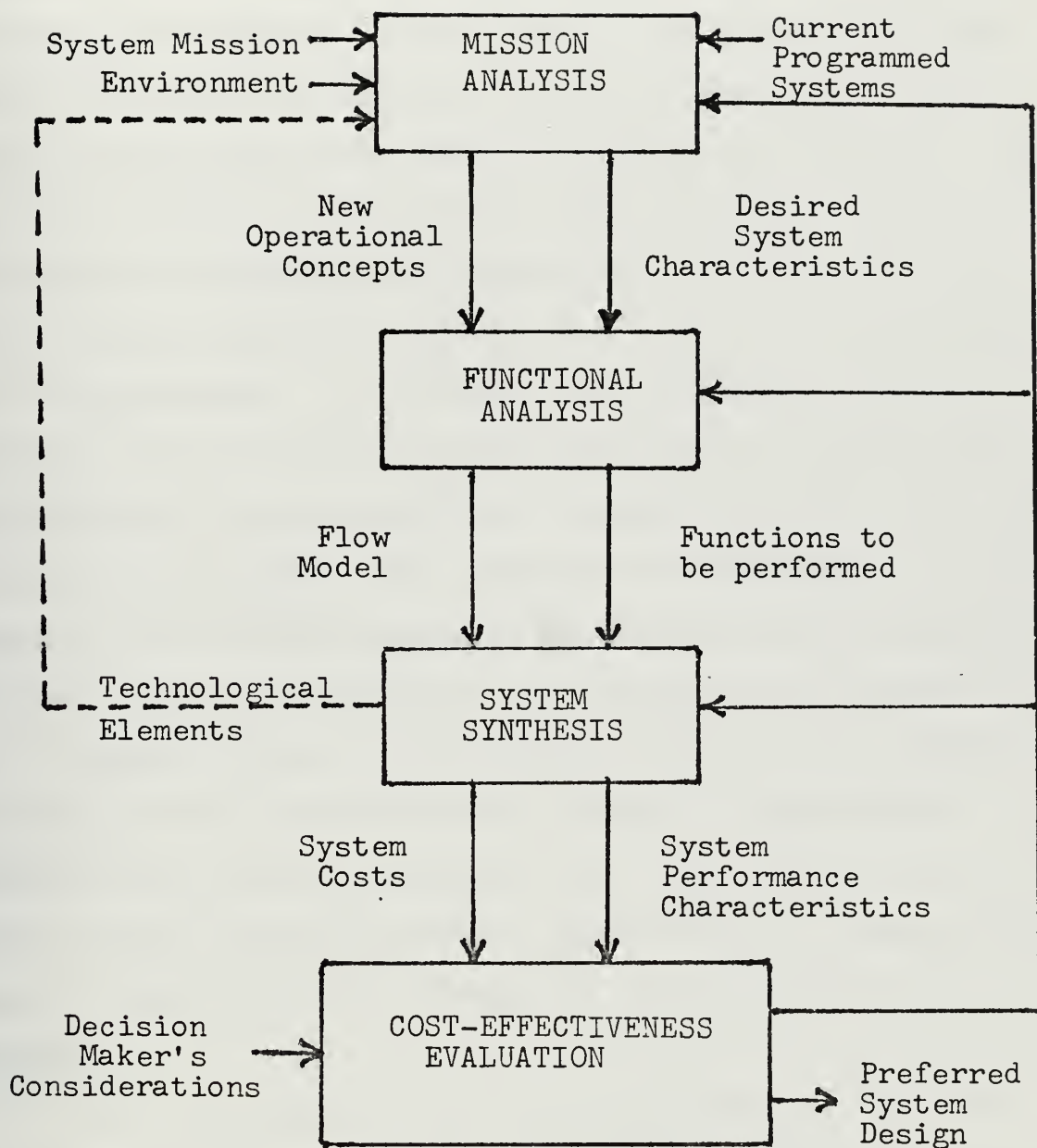


Figure 3. Work Process in System Planning

the organization is to perform and the environment which will interact with the mission. The mission itself is independent of people, equipments, or technology. The environment consists of the physical situation which is expected to exist during the time span over which the system will operate. During the functional analysis phase, the functional aspects of the problem are examined and various operational tasks that need to be performed are translated to system functions which must be implemented. The output of the system synthesis element is a set of feasible systems, each having specific system performance characteristics, including capacity, reaction time, and reliability. The output of the evaluation function consists of the effectiveness of each system and its resulting costs under the conditions or conditions which might occur. The end product of this iterative process is, ideally, an effective and efficient system design or change which optimizes the primary considerations. This logical, analytical systems planning process is applicable, in varying degrees of complexity and thoroughness, to all levels of command.

The remainder of this chapter will discuss the various elements of this model as they apply to telephone systems.

2. Service Requirements

The primary objective or mission of any Naval administrative system is to satisfy user requirements, while at the

same time, meeting established command and control prerequisites. Determination of those requirements is one of the most crucial stages in the telephone system planning process. In determining requirements, the services of the local telephone company representative should be utilized to the fullest extent possible. National and regional telephone administrative organizations within the Department of the Navy should be called upon for assistance as applicable. When considering large installation or major changes, detailed analyses of traffic volumes and characteristics, together with comparative service and cost data concerning alternative systems, are required in making such determinations.

Requirements must always be looked at from a long-term viewpoint and must be developed as early as possible to permit procurement prior to actual needs. This is particularly applicable when building construction is contemplated. Design of duct and conduct for underground cable plants must be included in building plans during planning phases.

Planning within individual commands should provide for adequate and reliable commercial telephone communications, as practicable, under all conditions. During emergencies or alerts, simulated or actual, TELCO may be called upon to provide new service or curtail service on short notice. Adequate prior agreements or arrangements must be concluded to provide service needs during emergencies and alerts. Requirements set forth below should be met to accomplish this objective

[COMELEVENINST 2305.1, 1965]:

1. Termination of Trunks. In manual TELCO exchanges, it may be desirable to have certain trunks designated for priority handling. In dial exchanges, special line assignments or termination of one or more trunks on a manual basis may be necessary to insure outgoing service during emergencies.

2. Toll Trunking Facilities. If the local TELCO central office is not a toll center, trunks to the nearest toll center should be considered and operating procedures formulated to insure prompt handling of emergency calls.

3. Maintenance. Maintenance of trunks and other circuits serving important activities should be arranged on a priority basis.

4. Trunk Routing. Whenever possible, alternate routing of trunks and other circuits should be provided to insure safeguards inherent in diversification.

5. Line Load Control. A method of eliminating unnecessary telephone calls during an emergency, particularly those of a local nature, must be established. This applies to outgoing calls from a switchboard as well as incoming calls. Many central offices are equipped with load control devices which restrict general telephone service during an emergency. DOD switchboards are given preferential treatment in this respect.

The requirements for any telephone system may be broken into the following hierarchial categories [Lewis, 1974]:

1. Mandatory - those necessary for the accomplishment of a given task.

2. Convenience - those which ease or facilitate job accomplishment.

3. Prestige - those which contribute to user ego satisfaction.

The scope of telephone communications requirements covers four broad questions [Lewis, 1974]:

1. Who does the user call?
2. How will he make his calls?
3. Who calls the user?
4. How does he answer his calls?

The answers to these questions must be made in terms of the three categories noted above. The manager or planner must be able to differentiate among basic service, extra features, and local/long-distance service requirements. Factors which must be considered include position or title of the user, working space layout, number of users to be served, workload of the user, and volume of incoming and outgoing telephone traffic.

Basic service is the provision of a telephone to one or more users in a specific location.

Extra features are those additions or arrangements which modify the basic service to increase utility, convenience, or prestige. These features include Private Business Exchanges (PBX), Call Directors, key systems, extension phones, dial intercoms, speaker phones, exclusion keys, and various line lights and buzzers.

Local/long-distance service involves a study of the tradeoffs between DDD, AUTOVON, WATS, and FX. Factors which must be considered are number and frequency of outgoing calls, destination, and average and peak duration per call. Since the choice among alternatives will have a significant impact on the cost-effectiveness of the system, each requirements

determination must be integrated with the systems plan. Strict guidelines and standards should be established and rigidly adhered to.

The General Services Administration provides detailed and comprehensive guidance concerning the type and scope of analyses needed in the determination of requirements for its telephone service [TCS P 7100.2A, 1972]. These directives (See Exhibits 1 - 3) give standards which are applicable to both regional and local levels for major installations or changes. At the present time, the DOD does not provide similar uniform guidance.

It is obvious that what is required in the systems planning process is a thorough investigation of service requests to ensure that user requirements and satisfaction needs are met in the most cost-effective manner. Where systems are already installed, ongoing studies must be made in order to eliminate or modify those aspects which are not cost-effective. For new installations, user-manager coordination at the earliest stage of the planning process is necessary in order to provide the most efficient and satisfactory system.

At the local level, it is imperative that a knowledgeable, experienced telephone systems planner be involved in the requirements determination process. Generally speaking, the end user has only a vague conception of his level of satisfaction and possesses little or no knowledge of the alternatives to his requested service.

INSTALLATION OF PBX EQUIPMENT OR CENTREX SERVICE

NEW SWITCHBOARDS OR CENTREX				ADDITIONAL SWITCHBOARD POSITIONS OR CENTREX SERVICE		REMOVAL OF SWBD POSITIONS OR CONSOLES	INTERCITY PRIVATE LINE				FTS ACCESS
CONSOLIDATION INTO PBX OR CENTREX SERVICE	FOR EXCLUSIVE USE OF AGENCY	CHANGES FROM OR TO DIAL SERVICE OR CENTREX	STATION GROWTH OR OVERLOADED SWITCHBOARD OR CONSOLES	CONSOLIDATION WITH EXISTING PBX OR CENTREX	TIE LINES BETWEEN SWITCHBOARDS OR CONSOLES		FULL PERIOD	FOREIGN EXCHANGE	DIAL REPEATING		
1, 3, 4A, 4B, 5A, 6, 7, 8, 14, 15, 16	4B, 5A, 5B, 6, 7, 8	1, 2, 4A, 4B, 5A, 6, 8, 14, 15	1, 2, 4A, 4B, 5A, 6, 8, 15, 16	1, 2, 3, 4A, 4B, 5A, 6, 7, 8, 14, 15, 16		1, 2, 5B, 6, 8	9A, 9B, 9C, 10, 15	12, 13, 15	12, 13, 15	12, 13, 15	11, 12, 15

INFORMATION REQUIRED TO JUSTIFY CHANGES

- COPY FROM THE TELEPHONE COMPANY OF THE MOST RECENT MONTH'S ITEMIZED EQUIPMENT STATEMENT AND ACTUAL COSTS, INCLUDING MILEAGE CHARGES, IN COMPLETE DETAIL FOR EACH AGENCY AND/OR SWITCHBOARD BEFORE THE CONTEMPLATED CHANGE.
- COPY OF THE FACE BILL FOR THE SAME MONTH OF EXISTING SWITCHBOARDS.
- COPY OF THE FACE BILL FOR THE SAME MONTH FOR EACH AGENCY INVOLVED.
- A COMPLETED GSA FORM 217, TELEPHONE OPERATOR COST DATA, IDENTIFYING THE SWITCHBOARD AND AGENCY INVOLVED, GIVING SEPARATE DATA FOR THE PERIODS:
 - BEFORE THE CONTEMPLATED CHANGE; AND
 - AFTER THE CONTEMPLATED CHANGE.
- ITEMIZED COST STATEMENT FROM THE TELEPHONE COMPANY INCLUDING THE NUMBERS OF POSITIONS, CONSOLES, CENTRAL OFFICE TRUNKS, AUXILIARY LINES, TIE LINES, TOLL TERMINALS, LINE FINDERS, SELECTORS, CONNECTORS, MAIN AND EXTENSION STATIONS, POWER PLANT, OFF-PREMISE MILEAGE, AND OTHER PERTINENT DETAILS, IF ANY, FOR:
 - NEW OR ADDITIONAL EQUIPMENT REQUIRED AND ESTIMATED MONTHLY COSTS.
 - CENTREX CO OR CU TARIFF RATES AND COSTS (SEE NOTE 1)
 - FACILITIES TO BE DISCONNECTED AND THEIR ACTUAL MONTHLY COST.
- TRAFFIC DATA FROM THE TELEPHONE COMPANY AS OUTLINED IN THE TRAFFIC ENGINEERING SURVEY SUMMARY FIGURE 2-3.2 (ALSO SEE CHAP. 5.) INITIAL EQUIPMENT REQUIREMENTS FOR THE CONTEMPLATED CHANGE.
- OFF-PREMISE MILEAGE AND COSTS CALCULATED SEPARATELY FOR EACH LOCATION SERVED OR TO BE SERVED.
- TOTAL TERMINATION CHARGES THE GOVERNMENT MUST PAY UPON THE REMOVAL OF FACILITIES, OR ASSUME UPON THE INSTALLATION OF NEW FACILITIES.
- BASED UPON AN ANALYSIS OF ONE RECENT MONTH'S TRAFFIC RECORD BETWEEN THE PARTICULAR SWITCHBOARDS PROPOSED FOR TIE LINE SERVICE:
 - AVERAGE NUMBER OF LOCAL CALLS PER DAY.
 - PERCENT OF PROPOSED TIE LINE CALLS DURING THE BUSY HOUR.
 - ACTUAL COST FOR THE MONTH FOR LOCAL CALLS MADE.
- MONTHLY COST OF TIE LINE AND TERMINAL EQUIPMENT FROM THE TELEPHONE COMPANY.
- STATEMENT OF TYPE PBX, NUMBER/TIME OF POSITIONS, NUMBER OF C.O. TRUNKS AND THE NUMBER OF OTHER (SPECIFY) TRUNKS.
- COPIES OF TOLL TICKETS, OR STATEMENTS COVERING 3 CONSECUTIVE MONTHS' TRAFFIC UPON WHICH THE REQUEST FOR A TIE LINE OR ACCESS LINE GROUP IS BASED.
- MONTHLY COST OF INTERCITY CIRCUITS IN DETAIL FROM THE TELEPHONE COMPANY, (SEE NOTE 2).
- ESTIMATE SPACE SAVINGS WITH CENTREX C.O. SERVICE AS OPPOSED TO 701-A DIAL SERVICE.
- ESTIMATE OF NON-RECURRING COST.
- REFER TO APPENDIX 2-A.

Exhibit 1. Required Information for Changes in Telephone Service

TRAFFIC ENGINEERING SURVEY SUMMARY (a)

Contracting Agency _____ Location _____ City _____

Traffic Data re Line Finders and 1st Selectors (b)

Data re
Present Operation
No. of Holding
B. H. Time No. of
Calls (seconds) Lines

Data re
Proposed Operation
Total LG L/LG
Lines (c) (d)

GR 1-9900
Intercomm.
Outgoing C.O.
Misc.

PL 2-5660
Intercomm.
Outgoing C.O.
Misc.

(Note: Not required for Centrex C.O.)

Traffic Data re Connectors

Data re
Present Operation
No. of Holding
B. H. Time No. of
Calls (seconds) Lines

Data re
Proposed Operation
Total Connector L/G
Lines Groups (d)

GR 1-9900
Intercomm.
Incoming Thru
Dialing

PL 2-5660
Intercomm.
Incoming Thru
Dialing

(Note: Not required for Centrex C.O.)

Traffic Data re Two-Way Manual C.O. Trunks

Data re
Present Operation
No. of Holding
B. H. Time No. of
Calls (seconds) Lines

Data re
Proposed Operation
Total CCS Trunks
Lines (e) Required

GR 1-9900
Incoming C.O.
to Extension
Outgoing C.O.

PL 2-5660
Incoming C.O.
to Extension
Outgoing C.O.

Exhibit 2. Traffic Engineering Survey Summary.

TRAFFIC ENGINEERING SURVEY SUMMARY (Contd.)

Traffic Data re One-Way Dial C.O. Trunks	Data re Present Operation			Data re Proposed Operation		
	No. of	Holding	No. of	Total	CCS	Trunks
	B. H. Calls	Time (seconds)		Lines	(e)	Required
QR 1-9900 Outgoing C.O.						
PL 2-5660 Outgoing C.O.						

Traffic Data re Position Requirements	Data re Present Operation			Data re Proposed Operation		
	No. of		No. of	Total		
	B. H. Calls	Coef.		Lines	Coef.	Units
QR 1-9900 Incoming C.O. to Extension Incoming Tie Line to Extension Outgoing Toll Outgoing Tie Line Transfers Directory Misc.						
PL 2-5660 Incoming C.O. to Extension Incoming Tie Line to Extension Outgoing Toll Outgoing Tie Line Transfers Directory Misc.						

- Submit in the format shown, or in other convenient and suitable form, all of the indicated information that is appropriate.
- Separately list telephone (PBX) numbers, or incoming trunk groups, serving the activities to be affected by proposed change.
- Indicate Line Groups as LG 1, LG 2, LG 3, etc.
- Indicate Working Lines per Group.
- Hundred Second Calls.

Exhibit 2 (Continued)

PERTINENT FACTORS TO BE CONSIDERED IN DETERMINING PBX
CAPACITY AND NUMBER OF POSITIONS.

- a. Number of telephones to be served by the PBX.
- b. Number of Central Office trunks required.
- c. Number of tielines to other PBX's.
- d. Holding time on all calls, including conversation and operating time.
- e. Calling rate, i. e., frequency and volume of peak hour traffic. Systems should be engineered to handle the maximum number of calls expected during the busiest calling hours.
- f. Number of requests for transfer of calls.
- g. Duties of the operators other than telephone operating work.

PERTINENT FACTORS TO BE CONSIDERED IN DETERMINING TYPE
OF PBX TO BE INSTALLED.

- a. Number of hours the switchboard is to be attended.
- b. Nature of the traffic handled, such as percentage of inter-communicating calls to total calls, etc.
- c. Nature of agencies served, such as whether their requirements are small, the agency is of a temporary nature, etc.
- d. Possibility of termination charges as determined by the status of Government tenure of the building in which the switchboard is to be located.
- e. Difference in cost and operating expense of the various systems.

Exhibit 3. Factors to be Considered in Determining Type and Size of Switchboard.

3. Types and Classes of Telephone Service

Central to the system planning process is a knowledge of the types and classifications of telephone service available. Requirements must be matched against these factors at the very outset of planning in order to provide for the most economical, feasible, and correct system in accordance with existing instructions.

Several types of service are available at any given activity. These include [Kerr, 1973]:

1. Administrative service provided by the local telephone company. For other than local service, DDD, WATS, or FX may be provided. The telephone instruments are the property of the telephone company. Removal, alterations, maintenance, or relocation except by company personnel is prohibited.

2. AUTOVON service providing direct interconnection with many military and other installations in CONUS and certain overseas areas.

3. Special circuits, such as direct voice, remote control, and data circuits provided via leased cable and equipment.

4. The Federal Telecommunications System Inter-city Voice Network (FTS) which permits calls to be made to government agencies located in nearly 500 cities and communities connected to the network. Calls may also be made to commercial (non-FTS) telephones. Recent directives normally prohibit activities having both FTS and AUTOVON simultaneously.

The following paragraphs describe various classifications of telephone service, as established by the Department of Defense, which may be provided as appropriate to the activities/offices serviced by the administrative telephone system.

Class A (Official) - Telephones which are authorized for the transaction of official business of the government on DOD installations and require access to commercial telephone company central office and toll trunks for the proper conduct of official business.

A-1 - Official business with access to AUTOVON as well as local commercial services, base, and commercial toll services.

A-2 - Official business with no AUTOVON access but with access to local commercial services, base, and commercial toll services.

A-3 - Official business with no AUTOVON or commercial toll access, but with access to local commercial services and the base system.

Class B (Unofficial) - Telephones which are installed within, or in the immediate vicinity of DOD activities are connected to DOD-owned or leased telephone exchange systems for unofficial use.

B-1 - Installed in government owned or leased quarters assigned for family or personal use in lieu of basic allowance for quarters and located within or in the immediate vicinity of a DOD activity.

B-2 - Installed for the use of public schools, the American Red Cross, and other quasi-government agencies such as the exchange and Federal Credit Union located on a DOD installation.

B-3 - Installed for the use of commercial contractors, concessionaires, and other business firms operating within, or in the immediate vicinity of a DOD activity.

B-4 - Installed in private or rental housing located within or in the immediate vicinity of a DOD activity. This type of service applies where commercial telephone service is not available, is inadequate, or is excessively expensive. When such telephones are located beyond base boundaries, additional necessary mileage charges rendered according to the tariffs of the local telephone company for similar service will be charged to the user for that portion of the circuit extending beyond the base.

Class C (Official Restricted) - Telephones authorized for the transaction of official business on a DOD installation without access to the telephone company's central office or toll trunks. These telephones should have indial capability for receiving distant calls from private lines and commercial trunk services.

C-1 - Installed for the transaction of Navy official business. When ARC personnel are employed to supplement the Navy welfare activities, Class C service may be provided with appropriate funds and without reimbursement. When a general administrative organization of the ARC, as distinguished from field personnel, is located on base, Class B-2 service, where authorized, will be provided at the standard charge.

C-2 - Installed on a Naval installation for the transaction of official business of other military services, for the use of any other executive department or independent government agency, or for use by other government agencies that furnish services to, or in support of, the Naval installation.

C-3 - Installed on a Naval installation for the transaction of official business of any executive department, independent agency, or other government activity except the Armed Forces.

Class D (Official/Special) - Telephones installed on a DOD installation for official business of the government and restricted to special classes of service such as fire alarm, security alarm, and crash alarm.

4. Changes in Service

Requests for local telephone service and/or changes in service will originate with the user activity [OPNAV Instruction 2300.4A, 1956]. NAVFAC P-68 delegates this authority to local commanders and specifies that this delegation is limited to telephone station installations, changes of location of stations, station extensions, wiring plans, key systems with stations that will accommodate up to six pickups (COMPAK II) and other standard basic equipment furnished by the contractor and billed in accordance with legally established tariffs. The activity requesting service is responsible for providing funds for the installation and continuance of the service required.

Changes in existing telephone service or proposed new installations require command approval as follows [OPNAVINST 5300.4A, 1956]:

1. Changes in existing telephone service which do not materially affect the authorized capacity of a local telephone system may be approved by the Commanding Officer responsible for the system. This category may include lines (excluding trunk and tie lines) and telephone terminal equipment up to the approved capacity of the switchboard.

2. Changes in existing telephone service which affect the capacity of a system or its engineered method of operation, or which require additional trunk or tie lines, or other exchange expansion may be approved by the Commandant or Area Commander concerned.

3. New installations, activation of inactive installations, complete rearranging of an existing system, expansion of an existing system by more than 100 lines over the last approved switchboard capacity, changes in ownership, conversion from manual to dial operation or similar major modifications will be submitted to the Chief of Naval Operations for approval via the appropriate chain of command.

Each activity operates under a Basic Termination Contract (BTC) with the local telephone company. Essentially, the activity agrees to retain the installed major equipment for a period of time (usually five years). Should the activity decide to terminate the use of the equipment prior to the end of the contract period, it would pay termination charges based on the time remaining in the contract. Changes ordered against this BTC are made through the use of Communication Service Authorizations (CSAs).

NAVFAC WESTDIV Instruction Processing of Communications Service Authorizations outlines in detail the procedures

for the preparation and submission of CSAs (DD Form 428). After investigation as to the validity of the change request, the activity prepares an original plus three copies of the CSA. The original plus two copies are then sent to the local telephone company with the third copy remaining with the activity as a suspense copy. The telephone company assigns a date and circuit or telephone number and forwards the original back to the activity. Upon completion of the change, another copy is returned to the activity. The activity then matches the completion copy against their suspense copy, updates the original and the suspense copy, and forwards the original to the EFD for filing. This process, although seemingly cumbersome, provides for effective managerial control and accurate record keeping.

At the local activity, telephone change requests, whether they be new installations or modifications to existing stations, are generally initiated through the submission of a work request by the requesting department head. The method of submitting work requests is universally detailed in local instructions. Once the work request is received by the telephone administration organization, the critical process of determining the accuracy and validity of the requirement starts.

5. Telephone System Cost Factors

Although there are many ways of breaking down and delineating the cost elements which make up the aggregate

telephone bill for a Naval installation, this section deals only with the direct, identifiable costs charged by the local telephone company and those costs applicable to the direct management process. Indirect costs such as activity overhead and costs associated with wholly-owned government systems are not discussed.

Telephone systems costs can be divided into two major categories: equipment and service, and management. These categories can be further subdivided as follows:

Equipment and Service

- Equipment/Lines
 - CENTREX/PBX
 - Stations
 - Key Stations
 - Dedicated Lines
 - General Use Lines
- Business Lines Outside the CENTREX
- Toll Calls
- Message Units
- Installation and Changes
- Miscellaneous

Management

- Regional
- Local

a. Equipment and Service Costs

By far the most expensive category in any installation's phone bill is the item labeled "monthly service charge." This item primarily consists of a monthly rental charge for installed equipment, lines, and instruments. In order to obtain a detailed, itemized listing of the individual charges, it is necessary to refer to the computer printout known as the "Green Sheets" provided with each bill by the telephone company. CENTREX or PBX service is charged at a

flat monthly rate. Instruments and their associated lines are charged at a monthly rate depending on the type of instrument (COMPAK I, II, III, IV). As will be discussed in more detail in a later section, the configuration of the key systems and their associated extra features forms a significant part of the service charge. Dedicated lines (teletypewriter grade, data lines, etc.) and General Use lines (alarm and control circuits) form a part of the service charge and are also billed at a flat rate. The monthly service charge can be essentially treated as a fixed cost within the system since it varies little from month to month (except as a result of changes or rate increases).

Toll or long-distance calls originating through the CENTREX comprise the most significant portion of the variable costs and demand a portentous amount of managerial attention. In any analysis of toll cost considerations the planner and manager must carefully weigh the choices of DDD (direct distance dialing), WATS, FX, AUTOVON, and private tie lines. The management problem is greatly compounded by the great variability of the incurrence of toll charges for different facilities and within each facility. This subject will be dealt with at greater length in a subsequent chapter.

The method of charging for local calls varies considerably from one geographic area to another. In most cases, telephones are available either with a flat rate or with measured service. In some areas, particularly large

metropolitan cities, message unit charges are applied. The charge can vary with the distance from the calling station. Insofar as overall costs are concerned, the charges for local telephone calls (message unit charges) rank just behind toll charges [Kerr, 1973]. Because of the large number and variety of parameters influencing this cost factor, any analytical study is exceedingly difficult.

Installation and change charges generally represent a small percentage of an installation's monthly telephone bill and vary considerably from month to month. However, a change in tariff rates could have a disastrous effect on this factor. Fortunately, these costs are particularly subject to effective managerial control.

Miscellaneous cost factors include directory advertising, federal and local taxes, and credits. For U. S. government activities, directory advertising charges are rather insignificant and taxes do not apply. Credits, which represent cable credits and allowances resulting from the telephone company's use of Navy-owned cables within an installation, are relatively stable from month to month.

b. Management Costs

Under the present management organization structure, the NAVFAC Division (EFD) employs engineers, analysts, accountants, etc., who function as managers and advisors for the telephone systems within its region. The EFD charges each activity a monthly rate for these services based on the number of used lines within the activity.

The major expense for the AUTOVON system is borne by COMNAVTELCOM. However, each activity is charged by the telephone company on a line per month basis for the terminal equipment at the switchboard.

Local management costs are essentially administrative costs which include clerical wages, switchboard operator wages, telephone directory costs, and installation overhead. Because many of the personnel involved in the administrative process also perform various other duties, the separation of costs relating directly to telephone administration is necessarily subjective in nature. Whether or not these costs should be included in any cost analysis of a telephone system is questionable.

B. SYSTEM EVALUATION

Effective telephone systems management requires a scheduled systematic review of facilities to provide continued efficient and economic telecommunications service. Optimum network efficiency and economy are obtained through the analysis of traffic data to assure that the quality and quantity of the communications channels, switching centers, and terminal equipment comprising the system is adequate but not excessive.

Traffic usage data is obtained by several methods. The most commonly used methods are [TCS P 7100.2A, 1972]:

1. Automatic data gathering devices, fixed and portable, used by common carriers to obtain information for determining the adequacy of existing facilities and requirements for increasing or decreasing facilities.

2. Manual recording of traffic data, normally accomplished by operating personnel using stroke, peg, plug, or two-minute usage count methods.

The GSA presently conducts several different traffic usage surveys on a quarterly, semi-annual, and annual basis. Due to personnel and financial resource limitations, the usage surveys and detailed traffic analysis studies of the type discussed in Section A-2 above are most applicable to regional level management for evaluation of major installations and in configuring new facilities or affecting modifications.

However, methods for the continuing evaluation of telephone systems at the local level are required. It is essential from an economic viewpoint that the methods used by local activity involve resources readily available to the activity. Several of these methods and tools will be discussed below.

The first and most readily available method is a periodic, objective, and conscientious review of the activity's equipment inventory and comparison with TELCO Green Sheets. This review should be conducted at least quarterly. Any discrepancies noted should be promptly corrected. Additionally, the local inventory record and TELCO-provided Key System Worksheets should be carefully studied in an attempt to eliminate inefficient configurations and costly extra features which are in excess of actual requirements.

Lewis and Heames [Lewis, 1974] have developed three statistical tools useful to the local manager in evaluating

the cost-effectiveness of a telephone system. These measures are:

1. Cost/Telephone/Month (CTM). This is the total service charge per month allocated to a particular department for all telephone service (straight lines, key systems, etc.) divided by the total number of telephones in use in the department.

2. Key System Premium Ratio (KSPR). This is the difference between the monthly key system cost and the cost of the basic line charges for the number of telephones in the system, divided by the latter. For example: a key system has a monthly service charge of \$141.00 and contains twelve telephones.

$$\frac{\$141 - (\$7.70 \times 12)}{(\$7.70 \times 12)} = .53$$

3. Line Access Cost Ratio (LACR). This ratio is derived from the Key System Worksheet. It is the cost of the number of effective telephones minus the actual key system cost divided by the latter. The cost of the effective telephones is the basic line charge (\$7.70) multiplied by the number of the individual telephones which would be required to provide the same line access as that available in the key system configuration. For example: a key system costs \$34.00 and has three telephones which have access to three lines each. This key system is equivalent to nine effective telephones.

$$\frac{(\$7.70 \times 9) - \$34}{\$34} = 1.04$$

If these values are computed for all departments and key systems and ranked in numerical order, the highs and lows, as appropriate, provide an indication for further evaluation.

The values provide a starting point in isolating departments or key systems where improvement effort may be best applied. If the CTM and KSPR of a system are high, excessive extra features are indicated. If the LACR is low, further study of the line and instrument arrangement is called for. High LACR values may indicate over-utilization and suggest a need for more service.

This statistical survey provides an excellent management tool for system evaluation. It is readily adaptable to computer format and need only be computed initially for all systems. Periodic reports could be generated to reflect changes made.

Another invaluable management tool available is a computer printout of long-distance calling patterns provided by the telephone company on request. These patterns can be utilized to identify and analyze suspected high cost users of commercial long-distance services. Additionally, for an activity as a whole, it can be used as a traffic analysis tool when considering tradeoffs among the various long-distance calling methods available.

It must be emphasized that the above evaluation techniques are not all inclusive nor in themselves a true measure of cost-effectiveness. As previously stated, the primary objective of any telephone system is to satisfy user requirements. The results of any objective system evaluation must be weighed against such subjective factors as department function, personnel composition, office layout, and personnel morale. Close coordination between the telephone coordinator and the departments/activities served is required to obtain optimum requirement satisfaction and cost-effectiveness.

C. COST CONSIDERATIONS

In order to provide the required telephone service in a cost-effective manner, the manager must be aware of the cost

elements of the individual cost factors and the tradeoffs among these elements. Section A-5 above discussed the various cost factors involved in a telephone system. This section analyzes the various cost elements that make up these factors. A breakdown of NPGS telephone costs for the period July, 1973, through October, 1974, is presented in Figure 4. Figures 5 - 10 demonstrate cost trends during this period.

1. Monthly Service Charges

The most costly factor in a leased telephone system is the monthly service charge. At the NPGS for the period July 73 to October 74, this factor comprised 73% of the average monthly bill. This figure corresponds with the findings of other studies: Kerr noted 60% in his study of the Point Loma complex at San Diego; Lewis noted 80% at NPGS [Kerr, 1973, and Lewis, 1974]. As previously noted, these charges are essentially fixed costs once a system is installed and vary only as minor changes are made within the installation.

NPGS TELEPHONE COSTS
JUL 73 - OCT 74

<u>ITEM</u>	<u>COSTS (\$)</u>
<u>Monthly Service Charge</u>	
Main Station	
Mean	8,805.08
High	10,190.17 (SEP 74)
Low	8,022.53 (APR 74)
Total Service Charge (incl. reimbursable activities)	
Mean	12,022.70
High	13,315.56 (OCT 74)
Low	11,574.14 (APR 74)
Pct of Avg. Total Bill	73%
<u>Tolls</u>	
Main Station	
Mean	2,498.50
High	3,283.28 (MAR 74)
Low	1,917.43 (AUG 73)
Total	
Mean	3,931.79
High	5,271.84 (MAR 74)
Low	2,875.84 (AUG 73)
Pct of Avg. Total Bill	24%
<u>OC/C</u>	
Total	
Mean	471.50
High	1,033.91 (JUL 74)
Low	94.71 (JUN 74)
Pct of Avg. Total Bill	3%

Figure 4. NPGS Telephone Costs

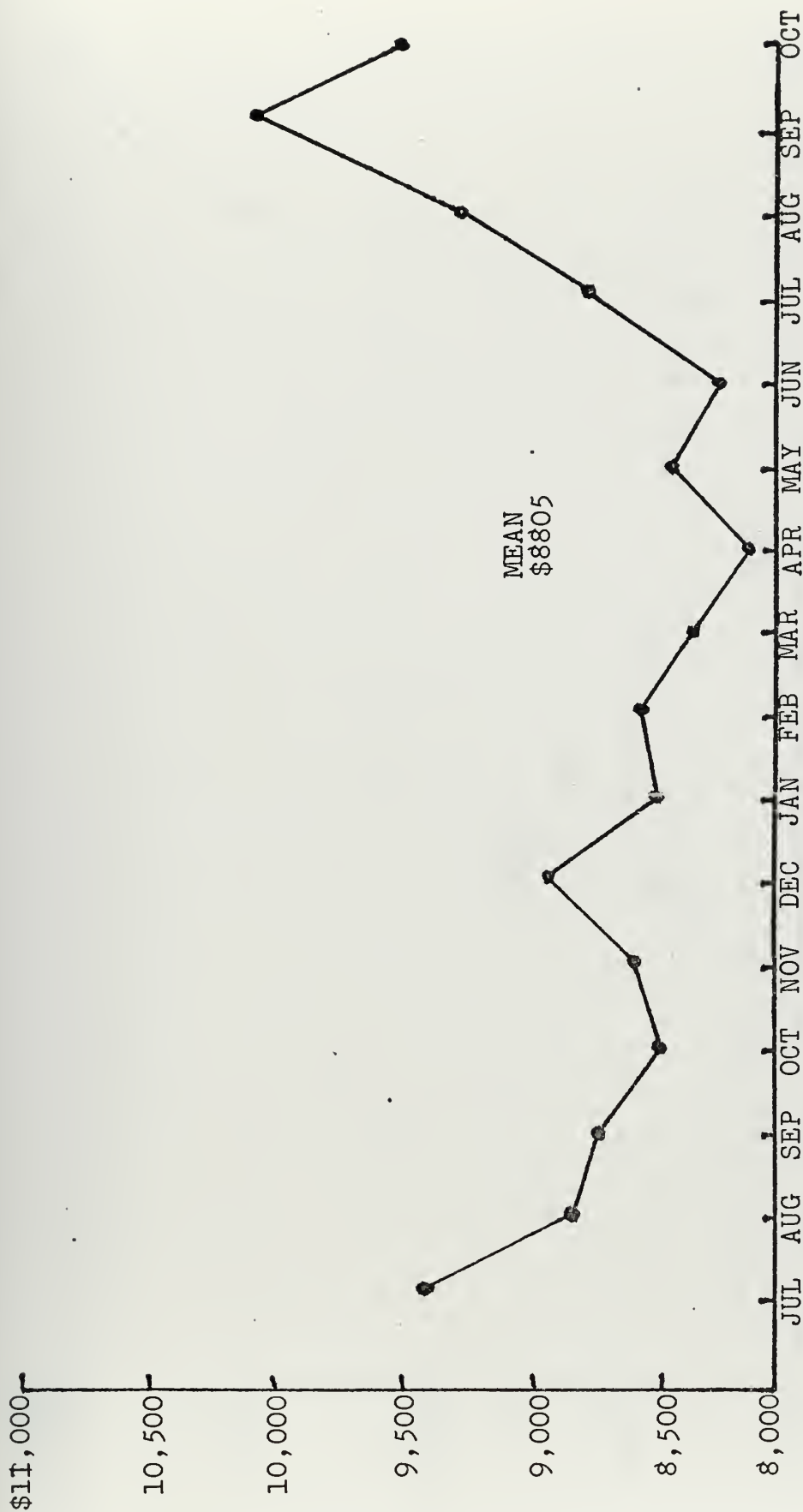


Figure 5. Graph of Main Station NPGS Service Charges, Jul 73 to Oct 74.

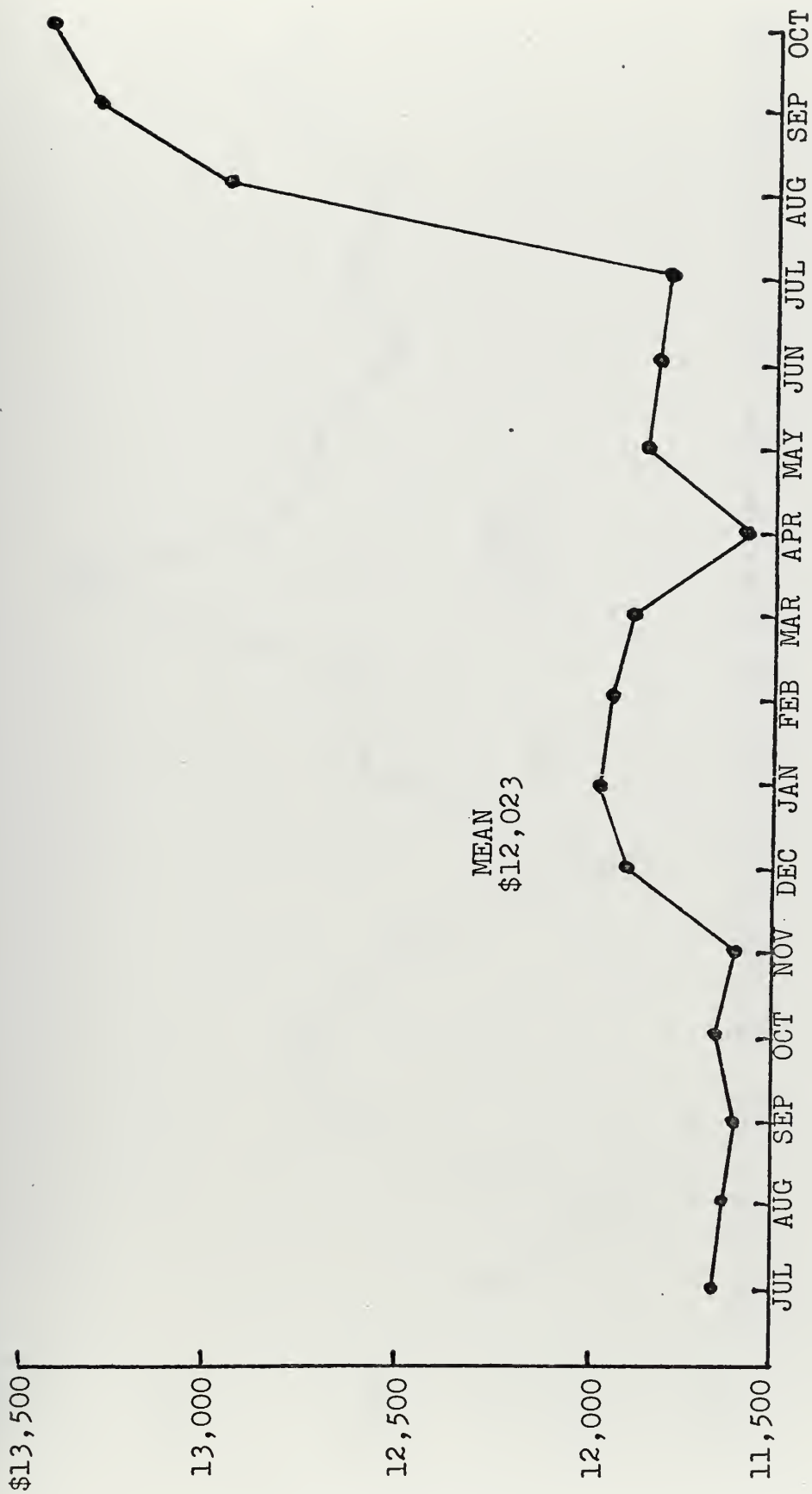


Figure 6. Graph of Total Service Charges, Jul 73 to Oct 74.

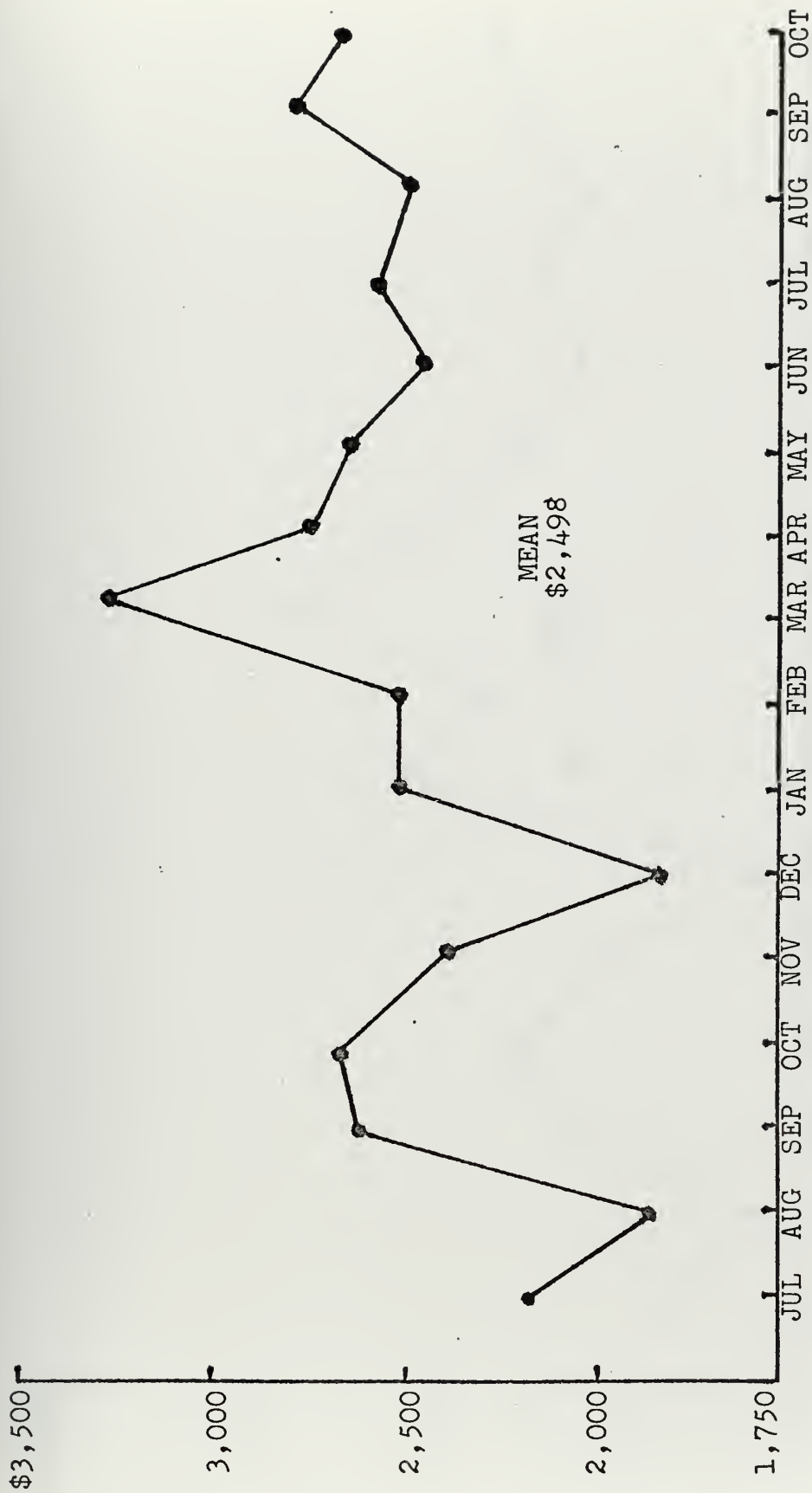


Figure 7. Graph of Main Station Toll Charges, Jul 73 to Oct 74.

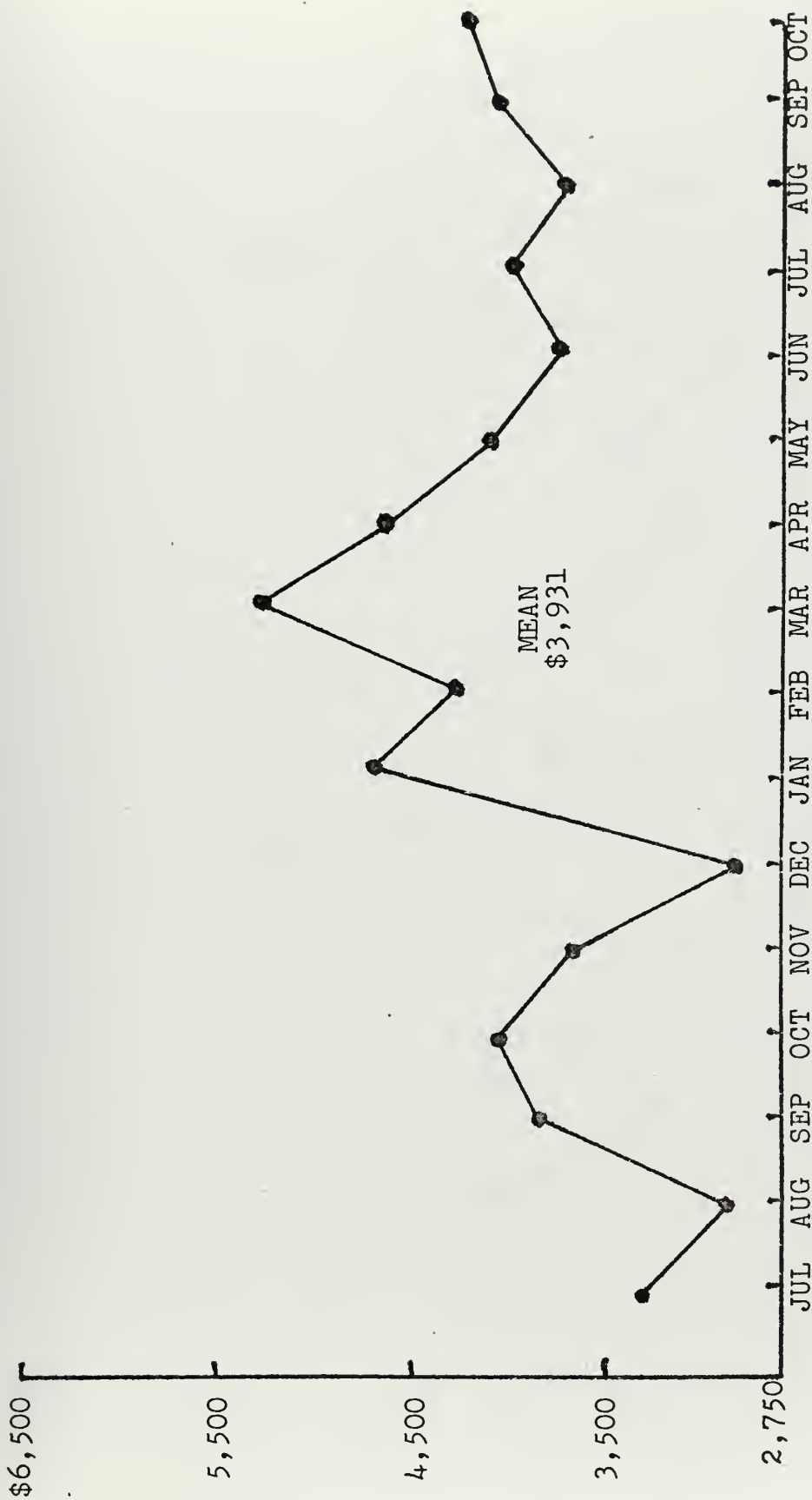


Figure 8. Graph of Total Toll Charges, Jul 73 to Oct 74.

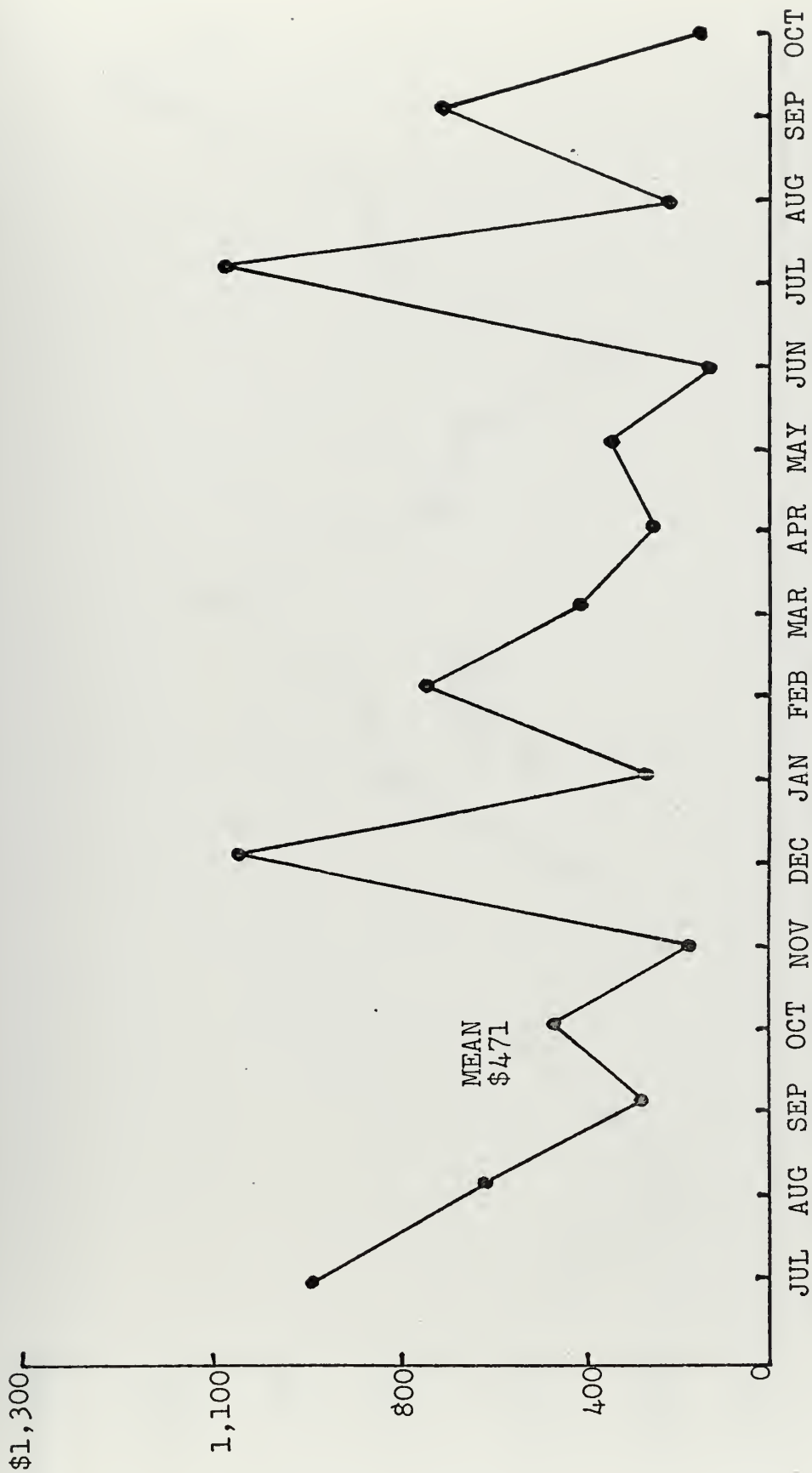


Figure 9. Graph of Total Other Charges and Credits, Jul 73 to Oct 74.

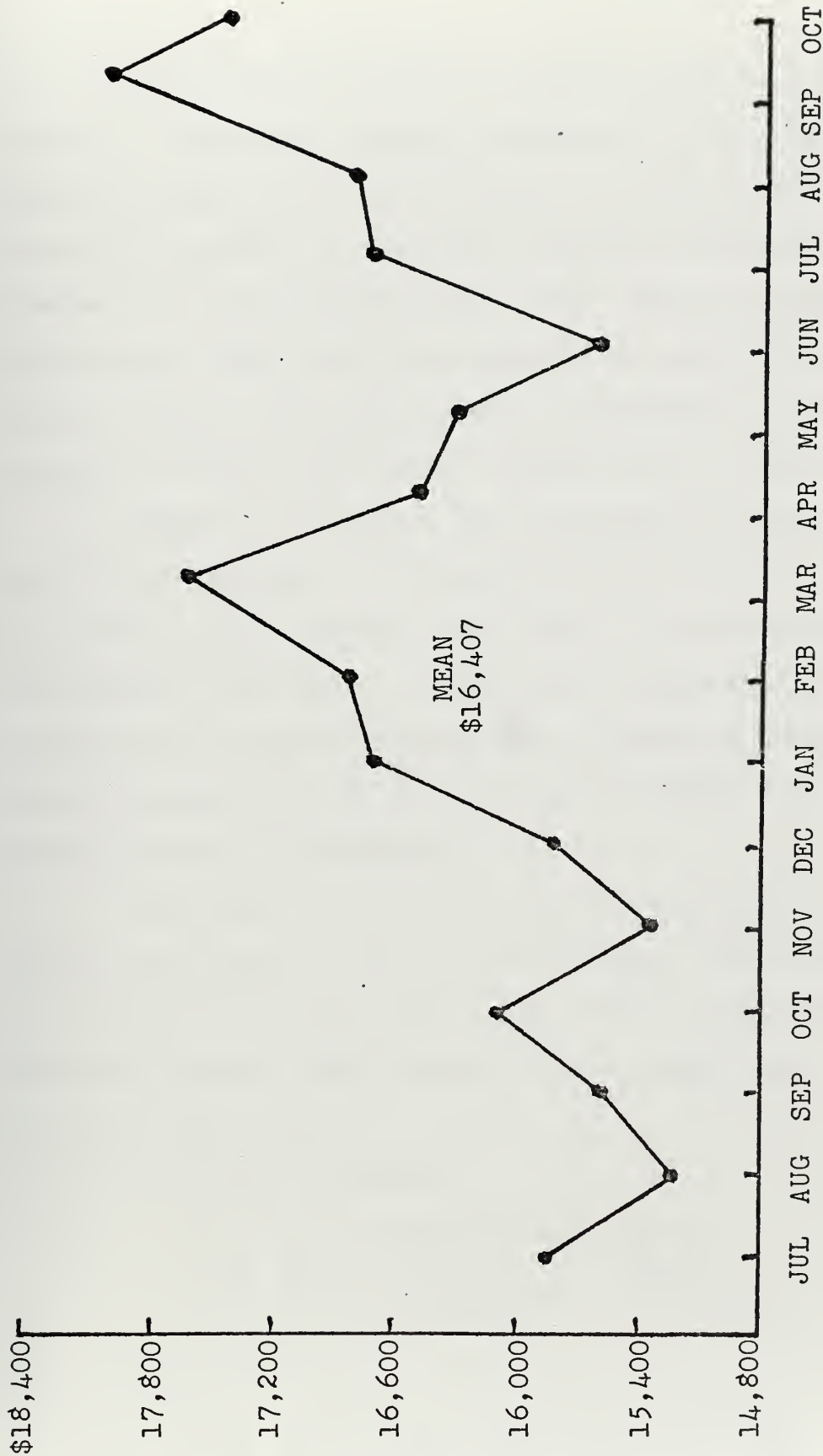


Figure 10. Graph of Total Telephone Charges, Jul 73 to Oct 74 (includes toll, service, directory advertising and other charges and credits for reimbursables and non-reimbursable activities).

One particular aspect of these costs is significant, however. The large increase reflected by the July-August 74 figures is due to a rate increase by the telephone company. In view of present inflationary economic conditions, rate increases should be expected with some degree of regularity in the future. This trend will greatly increase telephone costs; however, the proportionate percentage of service charges to total costs should remain fairly steady.

Within this factor, the predominate element is the cost of key systems. As found by Kerr and supported by Lewis, key system costs comprise about 50% of the total monthly service charge. The costs of individual key systems vary greatly in relation to their configuration. Most key telephone stations consist of six-button telephones (COMPAK II) with assorted features incorporated.

In order to provide a clearer understanding of key station features and costs, the following characteristics are presented (See Appendix A for further definitions of Universal Service Order Codes (USOC)). Costs are in addition to basic line charges.

a. Type Instrument

- (1) KX1 = single button (\$1.00)
- (2) KX2 = six button (\$2.20)
- (3) KX3 = call director (\$5.00)
- (4) EXT = extension (3.75 each)

b. Features

- (1) KFM = blinking lights (\$3.00 per station)
- (2) FJZ = signal and buzzer (\$.90)
- (3) BZZ = additional buzzer (\$.45)

- (4) SBV = busy lamp control unit (\$.75)
- (5) CUT = signal control keys (\$.75)
- (6) XL5 = exclusion key (\$.75)
- (7) EXB = extension bell (\$.70)
- (8) EXG = extension gong (\$.80)
- (9) DA9 = dial intercom first
nine stations (\$7.25)
- (10) DAD = each additional inter-
com station (\$1.65)
- (11) SP3 = speaker phones (\$6.25)

The costs for the added features can easily be computed by subtracting the costs of the aggregate key station instruments from the total key systems cost. While none of the features in themselves are very expensive, the total cost involved for any activity is significant.

Similarly, a "true features" cost can be computed by comparing costs of wholly straight lines versus straight line/key system configurations. Lewis computed this cost to be 23% of a typical month's service charge. In a hypothetical situation, Kerr postulated that if the 20,000 stations in the San Diego area consisted of 10,000 lines and 10,000 extensions and nothing more, the annual saving in monthly service charges would amount to about \$1,000,000.

One of the above indicated features, dial intercoms, is a relatively costly item and deserves further mention. Intercommunicating lines or intercom systems are line circuits that connect two or more main or extension stations independently of the serving PBX or CENTREX. These separate intercom systems may be either manual or dial. Manual intercoms require a separate external signal button to activate a buzzer signal at a distant intercom station. Dial intercoms provide

for separate selective station ringing and are the most common. They are essentially convenience items since the same result could be obtained by dialing the four-digit number for a particular extension through the CENTREX as by dialing a two-digit intercom number. Dial intercoms thus should not be required where an interstation dialing capability is installed. They have the most practical benefit for large business offices where there are a number of people performing similar functions and where any one person may be expected to answer incoming inquiries from several lines.

From the above discussion, it is clear that telephone usage requirements must be carefully studied before a key system is configured or justified. The manager must weigh each key system with respect to the hierarchial requirement categories. Kerr states that "there does not exist, at this time, any mechanism within the Navy for performing this function, even though this can have the largest impact of all the categories on telephone system costs. A reduction of \$1.00 per month per station in " monthly service charge" would save almost a quarter of a million dollars a year in the Navy's San Diego phone bill, which can easily justify the salary of one key system monitor or analyst."

Another factor of the monthly service charge that deserves attention is the area of private (dedicated) lines. These range from teletype grade lines to wideband data lines. Private lines are generally used for a single purpose and are

relatively costly. In view of the ever increasing application of, and demand for, data circuits, the present and future requirements for these lines must be carefully reviewed from an economic standpoint. Consideration should be given wherever possible toward consolidating services into wideband trunks such as TELPAK.

2. Toll Charges

As previously mentioned, the telephone company offers a wide choice of long-distance services. The choices available are: direct distance dialing (DDD); wide area telephone service (WATS) - both in and out; foreign exchange (FX); and private tie lines. These offerings must in turn be weighed against the use of AUTOVON and/or the Federal Telecommunications System Intercity Voice Network (FTS). Analysis to determine which combination of choices is optimum in any given situation often requires an elaborate computer program. One of the factors that adds to the problem of developing general conclusions with respect to toll charges is the great variability for different facilities and even within an individual complex.

Kerr found that toll calls represent only a little more than 20 percent of the direct bill [Kerr, 1973]. This figure is supported by current findings at NPGS (See Figure 4). In his study, Kerr analyzed over 4000 long-distance calls and found that the distribution of call times was generally exponential as shown in Exhibit 4. Of the total,

DURATION, MIN	NUMBER
1	960
2	694
3	554
4	495
5	369
6	296
7	219
8	182
9	142
10	119
11	91
12	68
13	72
14	53
15	37
16	38
17	32
18	15
19	15
20	21
21	17
22	12
23	11
24	13
25	7
26	12
27	6
28	10
29	11
30	3
31	6
32	2
33	2
34	0
35	1
36	1
37	4
38	1
39	0
40	0
41	1
42	1
43	0
44	0
45	0
46	0
47	0
48	0
49	0
50	0
51	0
52	1
53	0
54	1
55	1
56	1
57	1
58	0

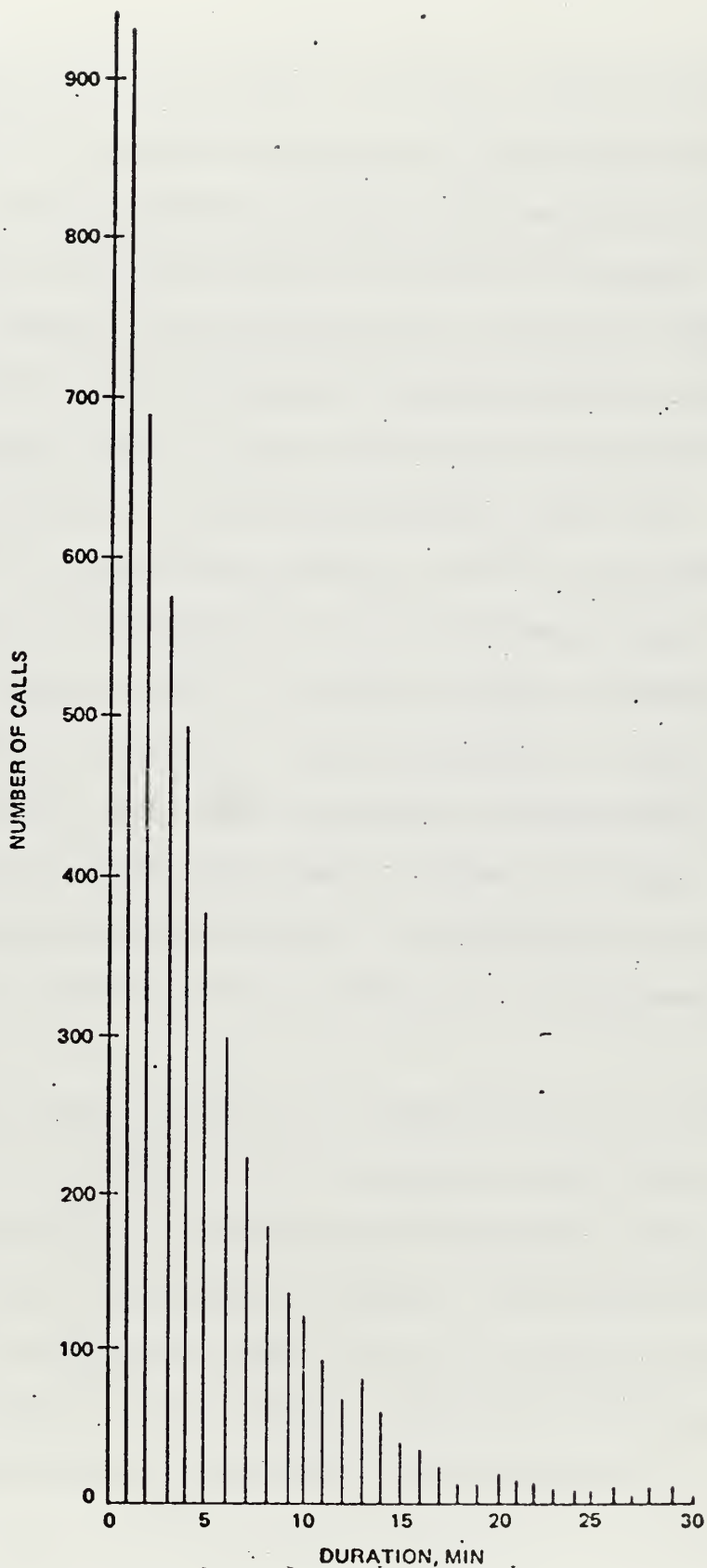


Exhibit 4. Distribution of Toll Call Times.

about one-half lasted less than three minutes. Of the total .. toll charges, the cost of calls lasting less than three minutes was a little over 20 percent. Thus, the remaining 50 percent of the calls are responsible for about 80 percent of the toll charges. Lewis' findings generally supported these results [Lewis, 1974]. These figures are particularly noteworthy for they suggest that if time constraints were placed on calls, or arbitrarily, if calls lasting more than ten minutes were audited, significant savings could be realized.

For purposes of discussion, it can be assumed that most toll charges reflect calls to locations where AUTOVON service is not readily available. (In the absence of adequate toll call control procedures, a study to accurately determine the number of toll calls made in lieu of using AUTOVON would be exceedingly difficult.) Accordingly, the use of WATS suggests itself as an alternative or supplement to DDD.

To determine what combination of WATS services could replace DDD requires a careful traffic analysis which measures the following parameters: (1) average call duration, (2) peak hourly volume, and (3) monthly volume. Achievement of a significant cost savings with WATS requires a special application with controllable, known demand. Haphazard ordering of WATS service, in cases where the demand or distribution of calls changes in time or in geographic distribution, or where the use of WATS cannot be strictly controlled, generally

results in cost increases. The WATS tariff is so constructed that unless all of the variables are adequately defined and compared by the systems planner, costs are invariably greater rather than less. As reported by Kerr, Pacific Telephone studies at the San Diego Naval complex tend to indicate that because the three parameters are not sufficiently controllable, the use of WATS services at military installations is not economically justifiable. These findings do not rule out the possibility, however, that under certain circumstances, and as a result of careful traffic analysis, WATS offers a viable alternative to DDD.

In the case of FX, the above considerations are generally applicable as well. The use of FX service in place of or to supplement AUTOVON would be most applicable where a large volume of short duration calls are made between nearby (but not local) activities. The advantages of not tying up the limited available AUTOVON lines with such calls could easily justify FX service provided savings are realized over DDD.

Because the rate structure of the AUTOVON network is not specifically related to long-distance rates, as is WATS service, the usage of AUTOVON in place of other long-distance methods offers considerable economic advantages. When considering AUTOVON as an alternative, two important points must be kept in mind: (1) AUTOVON's primary function is to provide a command and control telephone network, and not a

means for casual two-way communications; (2) while it may be possible to dial a distant AUTOVON switchboard and obtain a line to an off-net telephone, a casual AUTOVON user cannot count on such service, thus AUTOVON cannot, in many cases, be used as a substitute for either DDD or WATS.

A recent study at the Naval Postgraduate School found that the cost per call using AUTOVON was \$.27 compared to \$1.19 for DDD [Smithey, 1973]. This significant cost advantage may lead to the conclusion that an activity should increase the number of AUTOVON lines available. This conclusion may be erroneous unless it is supported by careful traffic analysis. The prime factor involved is the calling distribution with respect to the time of day and the areas called.

The following conclusions result from several studies of the AUTOVON SYSTEM:

a. AUTOVON calls are the most economical means of communicating and should be encouraged as the preferred means where available.

b. Providing for and encouraging net transfers of AUTOVON calls at remote locations could result in some DOD savings.

c. Increasing the number of AUTOVON circuits or tying AUTOVON and FTS together probably will not materially affect DDD costs, because the vast majority of DDD calls go to locations where AUTOVON (and FTS) is not available (i.e., non-government).

d. Better discipline and control in the use of AUTOVON should be initiated to reduce call times and spread out usage over the work day in accordance with the area called.

e. Insure all phones configured for long-distance dialing also have AUTOVON capability.

3. Local Calls

The method of charging for local calls varies considerably from one geographical area to another and may involve either a flat rate, a measured service rate, or message unit charges varying with the distance from the calling station. Where message unit charges are used, they have been found to be a significant part of the monthly bill.

A 1973 study of the San Diego Naval Complex by the Pacific Telephone Company indicated that 28 percent of the local calls were interbase calls. This figure would suggest a further study of the feasibility of consolidating all local activities in one CENTREX. Another alternative, political considerations aside, would be the utilization of interconnecting DOD-owned lines.

From the above TELCO study, the remaining 72 percent represent calls to other than Navy facilities. It is reasonable to assume that a high proportion of these calls represent strictly personal calls. One method commonly suggested to recover a portion of these costs is to deduct either \$1.00 from each employee's paycheck per month or the amount he

declares as an average per month in personal calls. Another alternative is to install readily available pay phones for use in making personal calls. This alternative does not seem feasible since the telephone company is on record as looking for an eventual 20 cents from coin telephones and this, in turn, will be used to pull up message unit charges. The idea of employing payroll deductions seems highly impractical due to the administrative burden involved. What is needed, and would present the most practical solution, is greater managerial control over personal calls. Although all commands routinely issue directives concerning personal telephone calls, what appears to be lacking is follow-up action to identify and control persistent abusers of the stated policies. This overview function must be incorporated as an integral part of the telephone management function.

4. Installation/Connection Charges

Another area of telephone costs deserves some attention. The telephone bill includes an item labeled "other charges and credits." Credits, which represent cable credits and allowances resulting from the telephone company's use of Navy-owned cables within the various bases and facilities, remains stable from month to month. The other portion represents installation/connection charges (OC/C) and is essentially comprised of charges resulting from moves, installations, connections, rearrangements, and changes. No charges are incurred for disconnections. As seen from Figures

4 and 9, these charges vary considerably from month to month.

The average charges for OC/C, as reported by Kerr and supported by current findings at NPGS, represent less than five percent of total billing charges. However, all indications point to increasing labor costs and a determination by the telephone company to eventually recoup its installation costs. A change in tariff could have a disastrous effect on this portion of the telephone bill. Clearly, strict control of OC/C charges by management, as dictated in system planning guidelines, is called for to keep these costs to a minimum.

With respect to the administration of the costs, the alternative has been proposed that this function be carried out by the responsible department (the user). By imposing the costs of telephone service on the individual department budget rather than the activity budget, it is felt that the department manager would become more cost conscious and effectively reduce his requirements accordingly. This alternative is rejected by the author. This situation would tend to further fragment the management function, which, in many cases, is already overly segmented. The lack of knowledge of telephone systems on the part of the department manager and the added administrative burden placed on him lend additional weight to the argument against this approach.

D. REMARKS

Figures 5 through 10 demonstrate the rising costs of telephone systems. While these charts represent a small, relatively isolated activity, the same trends, only greater in magnitude, are indicated at larger installations and complexes. This situation reinforces the need for an effective system management program at all levels. Central to this management effort is a need for comprehensive and universally applicable planning guidelines and policies, items which do not presently exist within the Department of the Navy.

Telecommunications management practices must be geared to the future and be concerned with areas such as the growth of competition to AT&T in switchboard and instrument equipment, in long-haul dedicated circuits, and in foreign attachments and the growth of facsimile and data traffic with increasing use of dedicated circuits. Planning must provide for the interaction of voice telephone communication with teletype, telegraph, letter, or other graphical means or requirements. The future requirements for land, air, and sea interface facilities must be studied.

There exists a problem in almost every construction project in that after construction is completed extensive modifications to the telephone system must be made to suit the needs of the users. Considerably more effort is required in the preliminary planning of the location and types of telephone units prior to final design and construction of

the facility. Efforts must be made to ensure that telephone locations are not changed just to suit personal desires.

Effective systems management requires scheduled systematic reviews of facilities to ensure cost-effective and responsive telecommunications service. Optimum network efficiency and economy are obtained through the analysis of traffic data to assure that the quality and quantity of communications channels, switching centers, and terminal equipment are adequate but not excessive. At each local activity, review techniques may be simplified but still must emphasize cost-effectiveness. Changes in tariff structure require on-going evaluation of DDD charges, every dial intercom, buzzer system, key system, and special arrangements such as WATS, FX, leased and private lines, and AUTOVON. In some instances, it may be possible to provide a less costly equipment arrangement that will adequately meet the needs of the user. However, the system should not be reduced to the point where small equipment savings are achieved at the expense of interfering with the person's work requirements. In this light, all requests for changes (CSAs) must be thoroughly and conscientiously reviewed. The tools necessary to carry out the above strategy for systems management are available; they must be utilized!

Kerr adequately summarizes the function requirements of the telephone system management process in the following points. Whenever possible, these functions should be handled on a centralized basis for an entire complex.

1. Plan for and implement tie line, foreign exchange lines, and shared dedicated data lines.

2. Negotiate with the local communications company regarding new tariffs, particularly to avoid message unit charges on interbase calls and to allow for common use of WATS lines.

3. Conduct statistical sampling and publish monthly data on volumes and lengths of toll calls and volumes of message unit calls to encourage user restraint and identify abuses.

4. Study the requirements and provide design guidance for economic key system configurations.

5. Provide statistical data and quality control for AUTOVON service.

6. Develop emergency plans for communications outages and overloads.

7. Project changes in communications requirements, equipment developments, tariff changes, and new service offering of the telephone company and its competitors in relation to the needs of all the facilities in an area.

Essentially what is needed, and paradoxically what is presently lacking, is the promulgation of management guidelines and standards combined with the assignment of direct responsibility for overall telephone system management.

Appendix C proposes specific guidelines and standards applicable to the local activity. This appendix is prepared in directive format in order to serve as a basic foundation for inclusion in local directives.

V. INVENTORY CONTROL

A. INVENTORY REQUIREMENTS

Integral to the management of any telephone network as a system is the requirement to maintain an accurate and up-to-date equipment inventory. The manager must be able to assure himself that the equipment on hand is in agreement with the current telephone company bill and that the equipment installed is adequate for its intended utilization. Additionally, as part of the systems planning process, he must know the location of each piece of equipment, its configuration, and the configuration of the system as a whole. As aids in this effort, the manager should have at his disposal, as a minimum, the telephone service equipment billing record (Green Sheets), key system wiring diagrams, and the activity prepared equipment inventory.

The Green Sheets (See Exhibit 5) are provided by the serving telephone company along with the monthly bill and list all services, equipment, features, and lines provided in accordance with company records. Charges are itemized by service, equipment, or line. For individual stations, the items are arranged by extension number. For each station, the date of installation, features, location, and charges are given. Additionally, key systems are broken out separately by key system number and list installation date, features, location, access numbers, and charged.

Key System Worksheets are provided upon request by the telephone company for each key system installed. They illustrate for each system the line composition, features attached, type of instrument, arrangement of stations to lines, access numbers, and the telephone location.

Equal in importance to the Green Sheets is the locally prepared inventory record. When accurately prepared and maintained, this record serves as an invaluable management tool. The inventory record should be based on a thorough and responsible physical inventory of all installed equipment. The record should be in a form that can readily be used as a base for evaluation of the system. Where possible, the inventory record should be computer based.

At the present time, the Public Works Department of the Naval Postgraduate School maintains only a log book record of telephone numbers assigned, where the associated telephone is located, and which department is responsible. A separate list is maintained by department of phone numbers assigned within that department. These records are used by the financial clerks in verifying telephone bills and not by management as a tool for system evaluation. Since a physical inventory of all installed equipment has never been conducted, these records are often found to be inaccurate and incomplete. No attempt has been made to reconcile these records with the telephone company Green Sheets.

B. REMARKS

Typically, the inventory aspect of the management program is overlooked or given only cursory attention. In order to ensure effective management of the overall system, the physical resources within the system must be known and must be presented in a format that is readily useable. Excessive reliance should not be placed on the local telephone company to perform this function. The Green Sheets are designed primarily to serve as a universally formatted report of equipment charges. They do not lend themselves as an effective tool for system evaluation at the activity level. The fact must be emphasized that the Green Sheets represent a compilation of telephone company records. Their accuracy as to actual equipment and features installed is subject to question.

It is imperative that the local activity maintain an accurate and up-to-date inventory record to supplement the Green Sheets and the Key System Worksheets. This inventory should serve as a basis for system evaluation and as a means of verification of the Green Sheets. Orders should be issued to remove or correct installations that do not agree with activity records. For those items being billed but not physically present, rebate is made for overcharges as far back in time as they can be identified. For those items located but not billed, the telephone company collects only the undercharge for the two previous months. Additionally, orders

should be issued to correct all situations that tend to cause work inefficiency conditions because of poor telecommunications arrangements.

Key System Worksheets should be maintained for each key system installation and should be used in conjunction with the Green Sheets and local inventory record for effective management control. Anytime a change is made to a key system, a new worksheet should be obtained from the telephone company. Complete CENTREX and activity wiring plans should also be maintained.

A sample format for an activity inventory record is provided in Appendix D. The inventory record is computer based and utilizes punched card inputs so that changes can be easily made. The report is structured so that it supplements, rather than replaces, the telephone company's Green Sheets. Data that is of particular interest to the local manager is provided. Printouts are provided that list the installed equipment by local department code, physical location, and access number. This format offers a vehicle for system evaluation by focusing attention on total equipment installed, segregation of equipment within an activity, and number of stations available to any individual user. Excesses or deficiencies in the system installation can be readily identified. User requirements and requests for service or changes can be compared against the requirement hierarchial categories (mandatory, convenience, prestige).

In order for any local inventory record to be of effective use, it must be periodically verified against the Green Sheets and be conscientiously maintained. The advantage of increased system visibility offered to the telephone coordinator by this management tool outweigh the costs associated with the slight increase in administrative burden.

DATE	A	QTY.	USOC	LINE(S)/ OR KS/NO	OFF PRIM CCLG	LISTINGS AND EX	NATIONS	TOTAL
				2142		KS 80		5755
				2143		KS 94		195
				2144		KS 94		5755
53074		1	NRXS4	2145		A BLDG 232 RM 037		195
53074		1	RXR	2145				5755
				2147		KS 64		195
93074		1	NRXS1	2148		A BLDG 235 RM 111		5755
93074		1	RXR	2148				195
102474		1	HCU	2148				5755
93074		1	LPN	2148				195
93074		1	NN6	2148				5755
				2150		KS 80		195
				2151		KS 35		5755
				2152		KS 35		195
				2153		KS 35		5755
101072		1	NRXS4	2154		A BLDG 233 RM 222		195
3 172		1	RXR	2154				5755
				2156		KS 67		195
				2157		KS 94		5755
				2158		KS 3		195
3 172		1	NRXS4	2159		A BLDG 259 RM 113		5755
3 172		1	RXR	2159				195
3 172		1	NRXS4	2160		A BLDG 232 RM 434		5755
3 172		1	RXR	2160				195
102474		1	NRXS1	2161		A BLDG 330 RM 233		5755
102474		1	RXR	2161				195
				2162		KS 20		5755
				2163		KS 20		195
				2164		KS 20		5755

DATE	QTY	USOC	LINE/STAY OR RS/HO	PRINT DATE	AKIA CODE	CUST CODE	IN NO	TOTAL
71274	1	NRXS1	2426	010875	408	462	646 9C11	
71274	1	RXR	2427					575S
43073	1	NRXB3	2428					195
43073	1	RXR	2429					575S
5767	1	RFN	2430					195
			2431					
			2432					
			2435					575S
12772	1	NRXS1	2435					195
3172	1	RXR	2436					575S
3172	1	NRXS3	2436					195
3172	1	RXR	2437					575S
3172	1	NRXS4	2437					195
3172	1	RXR	2437					575S
5767	1	EXT	2437					375
5767	1	EXG	2437					00
3172	1	NRXS4	2438					575S
3172	1	RXR	2438					195
5767	1	EXT	2438					375
5767	1	EXG	2438					00
82967	4	1LVBY	2438					280
3172	8		2438					
121073	1	NRXS1	2439					575S
121073	1	RXR	2439					195
			2441					
			2442					
			2443					
			2444					
111573	1	NRXS4	2444					575S
111573	1	RXR	2444					195

Exhibit 5 (Continued)

A. 7012E (4-43)		PAGE NO.	42	PRINT DATE	010875	AREA CODE	408	CUST. CODE	462	TEL. NO.	646 9011
DATE	A	QTY.	USOC	LINE/STA/ OR KS/NO	F CODE	R. CODE	LISTINGS AND EXPL. ACTIONS		TOTAL		
122072		1	RXR	25		STA	2660		195		
122072		1	NRXS1	25		STA	2732		575S		
122072		1	RXR	25		STA	2732		195		
122072		2	KX1	25					200		
122072		1	*RF	25		A	BLDG 330 RM 215	SUBTOTAL KS NO 25	1740		
3 172		1	NRXS1	26		STA	2441		575S		
3 172		1	RXR	26		STA	2441		195		
3 172		1	NRXS4	26		STA	2442		575S		
3 172		1	RXR	26		STA	2442		195		
3 172		1	RXS4	26		STA	2443		575S		
3 172		1	RXR	26		STA	2443		195		
4 1269		2	KX2	26					440		
102072		2	891	26					900		
4 1269		3	KFM	26							
5 767		1	*RF	26		A	QTRDCK BLDG 220				
32770		1	*RF	26		B	OTH SERV KS 95	SUBTOTAL KS NO 26	3650		
3 172		1	NRXS1	27		STA	2236		575S		
3 172		1	RXR	27		STA	2236		195		
3 172		1	NRXS4	27		STA	2237		575S		
3 172		1	RXR	27		STA	2237		195		
5 767		1	EXT	27					375		
21374		3	KX1	27					300		
5 767		1	*RF	27		A	ADMIN & LOG BLDG 220	SUBTOTAL KS NO 27	2215		

Exhibit 5 (Continued)

VI. TOLL CALL MANAGEMENT

As discussed in Chapter IV, one of the most significant variable cost factors (greater than 20 percent of the monthly bills) is toll costs. This chapter will review the administrative procedures and controls involved in accounting for toll calls. The discussion is based on procedures at the Naval Postgraduate School. While these procedures are not necessarily representative of all Naval activities, they do typify many of the administrative problems faced by the manager.

A. CLERICAL PROCEDURES

With regard to the monthly telephone bill, the primary function of the Public Works Department, the telephone administrative organization at the NPGS, is to verify its accuracy. By far, the greatest amount of effort (man-hours) expended for this function is in verifying toll calls.

Within the monthly bill, toll calls are itemized on charge slips by extension number. The telephone clerk segregates these by department and submits the slips along with a certification form (See Exhibit 6) to each applicable department. Each department is responsible for verifying the toll calls made from telephones under its cognizance in accordance with its own internal control procedures. Any calls that cannot be initially accounted for are noted on the form which is returned to the PWD. This process takes approximately one and a half weeks from receipt of the bill.

RETURN PRIOR TO:

NAVAL POSTGRADUATE SCHOOL
MONTEREY, CALIFORNIA

NC4(43A)bvs

MEMORANDUM

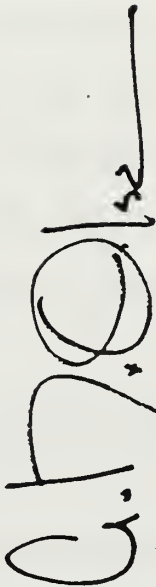
From: Assistant Public Works Officer (Code 43A)
To:

Subj: (1) Monthly Listing of Subject Calls for Period Ending _____

1. Enclosure (1) is forwarded for review, certification and return to the Telephone Officer (Code 43A).
2. It is essential that this certification (with enclosure (1)) be returned prior to the date indicated above to prevent assessment of penalty charges.

From:

To: Assistant Public Works Officer (Code 43A) A. N. OLSEN



1. Enclosure (1) has been reviewed and is returned herewith, certified as correct for payment. Exceptions are listed below.

(Signature)

EXCEPTIONS: This Department Has No Record of the Following Calls

From Extension	Date	Place and Number Called	Charges
----------------	------	-------------------------	---------

Exhibit 6. Toll Call Certification Form.

The clerk then compiles a list of all discrepancies and verbally relays this information to the serving telephone company's central office. As a service provided at no charge, the telephone company traces each of the unverified calls and reports back to the PWD. The PWD clerk must then contact each department individually, providing the results of the telephone company's tracing action in an effort to verify the calls.

Under most circumstances, the individual responsible for placing the call can be located and the call verified. If the call was made for official business purposes, the fact is so reported to the PWD and no further action is required. If the call was of a personal nature, the individual may elect to either pay for the call or have the charges transferred to a private line. In the latter case, the clerk must recontact the telephone company and direct this transfer.

Occasionally, however, this internal tracing defies all efforts to locate the responsible party. Unless the PWD can show that the billing was erroneous, such as when a call has been placed from a phone that was reportedly disconnected, the activity must accept the charge as it stands. Fortunately, this situation occurs infrequently.

In total, the process of bill preparation takes approximately four weeks for one clerk spending 25 percent of her time on this function.

From a survey of the telephone bills at the NPGS for a six month period (Apr 74 - Sep 74), it was found that

approximately 2.6 percent of the dollar value of all toll charges required additional verification. Of those calls requiring verification, 76 percent were for less than \$3.00 and 83 percent were for less than \$4.00. These figures indicate that an inordinate amount of effort is expended in order to verify costs that are relatively insignificant (approximately six-tenths of one percent of the total monthly bill)! This situation thus suggests that if an arbitrary baseline is established, say \$3.00, whereby all unverified calls below this level were not investigated, a considerable portion of the clerk's time could be saved. Since some personnel might be expected to take advantage of this situation, the possibility exists that the number of unreported inexpensive calls would increase. Therefore, with the loosening of control at the activity level, it follows that tighter control of toll calls must be exercised by the departments.

B. CONTROL PROCEDURES

Within each Naval activity, policy directives are promulgated concerning toll calls. At the NPGS, the following directives are in effect [NPGSINST 5000.3D, 26 Mar 71]:

1. Department heads are responsible for telephones in their spaces and are authorized to approve toll calls. It shall be the responsibility of the approving authority to determine that the toll call is necessary and that less expensive means of communication have been considered and determined to be inadequate.

2. Tolls incurred by Naval personnel who have occasion to call Naval activities on official government business from their residence, or any other location, may not be reversed unless prior arrangements have been

made for the receiving end to accept them. Collect calls may be accepted by the Officer of the Day from persons making emergency or required accident reports. Naval personnel absent from the station on duty may call collect to the cognizant department head when situations or conditions are encountered which require immediate consultation with higher authority, or additional clarification of original orders. Persons accepting collect calls under these circumstances shall immediately advise the Public Works Telephone Officer in writing.

3. Unofficial toll calls on official phones are governed as follows:

a. No person, except those regularly billed by the Telephone Officer for unofficial telephone service, are authorized to use station telephones for personal calls involving toll charges.

b. Public (coin box) telephones have been installed in various buildings for convenience of personnel who may desire to place or receive personal toll calls.

From a survey of various administrative and academic departments at the NPGS, it was found that in the implementation of these directives, no uniform control procedures existed. Accountability for toll calls was found to vary from none at all to very strict control. Tight control is exemplified by situations where department heads, or designated representatives, approved all toll calls beforehand or conscientiously reviewed call records after the fact. Not surprisingly, those departments exercising tight control generally reported the least number of unverifiable calls.

Another significant problem noted was that department secretaries responsible for departmental toll call administration lacked uniform guidance and were generally not knowledgeable about activity policies concerning the placing,

transfer, reporting, or budgeting of toll calls. This lack of standardization and training reflects directly on the number of unverifiable calls and on the administrative burden of the PWD and the departments themselves.

The Department of the Navy provides a toll call record form (See Exhibit 7) for use in accounting for toll calls. Most, but not all, departments utilized this form, or a similar locally prepared form, to account for toll calls. This form provides an excellent means for authorizing and verifying toll call charges. Where used, accounting procedures are greatly simplified and generally more accurate.

C. REMARKS

In order to ensure adequate control and accountability for toll calls, specific guidelines and standards must be developed and promulgated at both the headquarters and local level. Local directives must be comprehensive and specific with respect to the responsibility for authorizing toll calls, situations when toll calls are and are not authorized, the alternatives to commercial service, accountability procedures, and the use of the FCC precedence system for emergency situations.

Adequate training must be provided to ensure that all applicable directives and procedures are understood. Personnel must be made aware that commercial toll calls are to be kept to a minimum and that such calls are subject to auditing and monitoring. Additionally, personnel involved in the

administrative process must be sufficiently trained so that they can exercise their responsibilities in a standardized, efficient manner.

At the local level three alternatives are available for control of toll calls, namely: no or very loose control; strict control at the departmental level; and strict control at the administrative organization level.

The first alternative, which is a common practice among many civilian organizations, is not considered effective at military installations because of the strict budgetary constraints and controls under which they operate.

The third alternative, which, due to a lack of enforcement of stated policy, encompasses the present situation at the NPGS, is a viable alternative. However, providing strict control at the administrative organization level (PWD) necessarily involves a great expenditure of valuable man-hours. Because of the trend toward reduced manning levels in the foreseeable future, this alternative is seen as placing an excessive burden on the limited personnel resources.

The second alternative, which places responsibility at the level where control can be most directly exercised, is considered the most effective. The department manager is in the best position to apply and enforce activity policy. By employing standard guidelines and accountability procedures, such as the use of the Toll Call Record Form, toll calls can be kept to a minimum. Abusers can be readily identified and

TOLL CALL RECORD
NAVSO 2305/2 (Rev. 11-69)
3/ N-0104-900-3321

1. Call only if more economical, or if essential to save time.
2. Where applicable, obtain prior authorization to place call.
3. Organize data and thoughts; keep call brief.
4. Do not ask telephone operator to time call.
5. Submit form to office services section for control/audit use.

CALL MADE BY (Name, organization)		FROM (Location, area code, telephone)		DATE OF REQUEST
PERSON CALLED (Name, organization, location, area code, telephone)				DATE OF CALL
DURATION OF CALL (Minutes)		CHARGES (Check one each)	STRAIGHT	REGULAR BILLING
Planned	Actual		REVERSE	CREDIT CARD
SIGNATURE OF PERSON, (Check one or more)			REQUESTING AUTHORIZATION	
			MAKING STRAIGHT CALL	
			ACCEPTING REVERSE CHARGE	
MATTERS DISCUSSED, AND JUSTIFICATION FOR THIS CALL (Use reverse if necessary)				
APPROVED BY (Signature)			DATE	AUTHORIZATION NO.

Exhibit 7. Toll Call Record (NAVSO FORM 2305/2).

appropriate corrective action taken. As previously discussed, the department manager should establish the requirements for telephones under his cognizance. In this regard, telephones with out-dial (dial '9' or S1/S4 code) capability should only be so configured where absolutely necessary. Also, the department manager has direct control over the security placed on telephones by employing dial locks or ensuring the instruments are located in a lockable space. For reasons previously discussed, control over telephones, including toll call control, at the departmental level, should be exercised through administrative procedures rather than budgetary constraints.

In summary, what is required at any activity is a comprehensive toll call policy based on Navy-wide directives and a standardized control system to ensure that toll calls are minimized. Regardless of how the control system is organized, it must be uniform in applicability and conscientiously enforced.

VII. CONCLUSION

Historically, Naval administrative telephone systems have been managed as utilities and not as an integral part of established telecommunications networks. In contrast with the other branches of the DOD, this duality in command relationships has led, in part, to the fragmentation of responsibility for effective end-to-end telecommunications within the Navy.

As a result, what is missing in the management structure is the ability to deal with telephone communications as a system. This fact becomes particularly pertinent when considering the present-day and future need for effective nationwide and, in many cases, worldwide, command and control telecommunications systems. At the national command level, telephone systems must be managed as an integral part of the telecommunications networks. This will lead to greater responsiveness to DCA operational direction and management control, provide uniform management of telecommunications within the DOD, and provide true visibility of telecommunications resources.

As the tone of telecommunications management continues to shift more towards end-to-end management, both regional and local telephone administrative organizations must increasingly focus on a systems approach to telephone management. At the local level, it is essential that a telephone coordinator be designated and be given broad authority in the planning

and administrative areas. This will have the effect of centralizing the telephone management function and lead toward the goal of a responsive and cost-effective end-to-end telecommunications system.

Integral to a centralized management structure is the requirement for a comprehensive set of telephone administration standards and guidelines consistent with Naval telecommunications policy and applicable to all levels of command. This thesis has found that the present lack of such standards in the Navy is a significant contributing factor in the inability of management to deal with present-day telephone installations as a system.

Specifically, procedures must be developed at each local activity to provide for continuous evaluation of the installed telephone system to ensure responsiveness to DOD telecommunications while at the same time satisfying local user requirements in a cost-effective manner. A telephone master plan must be established to define present and future telephone requirements and to allow for analysis of the tradeoffs between the various long-distance options available. Management tools such as cost versus utility analyses and an accurate equipment inventory must be developed and fully exploited to promote efficiency. In the present environment of increasing telephone costs and restrained budgets, cost factors, particularly key systems and toll calls, must be periodically evaluated and compared with present and future requirements. Administrative procedures and controls must be standardized within

each activity in order to effectively support the management function.

With the expanding growth of telecommunications technology in the future, telephone systems will come to play an increasingly important role in the administrative and command and control functions associated with a Naval activity. Management can no longer remain simply a ministerial function, but rather, must be system oriented in an analytical sense.

APPENDIX A

Glossary

Automatic Voice Network - DOD system of leased facilities DOD installations worldwide.

Business lines - direct commercial telephone service.

Central Exchange (CENTREX) - a system providing switching equipment separate from that at a central telephone office for all telephones at a central location such as a military base.

COMPAK I, II, III, IV - telephone company designation for a basic one, six or multi-button telephone instrument (Call Directors).

Commander, Naval Telecommunications Command (COMNAVTELCOM) - exercises command responsibility over Naval telecommunications including telephone systems.

Communications Service Authorization (CSA) - document required to order the required telephone services by the government against the basic effective contract from commercial telephone companies.

Defense Communications Agency (DCA) - manager for the Defense Communications System of which AUTOVON is a part.

Direct Distance Dialing (DDD) - the common commercial method for long distance access.

Engineering Field Division (EFD) - sub-level of the NAVFACENGCOM concerned with area management of telephone systems.

Extension station - an additional telephone connected to a common telephone line.

Federal Telecommunications System Intercity Voice Network (FTS) - Federal agency telephone network managed by the General Services Administration.

Foreign Exchange (FX) - a non-local interarea calling service provided by the telephone company.

Green Sheets - the telephone company monthly listing of all equipment for which a particular system is being charged.

General Services Administration (GSA) - the Federal agency exercising responsibility over the FTS.

Intercommunications system - commonly part of a key system enabling interstation communications over installed telephone lines.

Key station (KTS) - a group of key stations interconnected by one or more lines.

Key System Worksheets - individual key system configuration charts provided by the telephone company.

Leased line - any common user line or trunk leased from the telephone company.

Naval Facilities Engineering Command (NAVFAC) - exercises maintenance, procurement, and business administrative responsibility for Naval telephone systems.

Private Branch Exchange (PBX) - the switching equipment of a CENTREX system.

Private (dedicated) line - a sole-user, non-switched, line, capable of being conditioned, leased from the telephone company for a specific purpose.

Rotary hunt - an incoming call is automatically transferred to the next higher number when a busy line is encountered.

TELPAK - various groupings of lines offered by the telephone company as a "bundle" at reduced rates.

Treatment - the dialing ability of a line or the restriction imposed on the dialing potential of a line:

S1 - AUTOVON and off-base capability

S3 - on-base only

S4 - off-base only

Trunk - a line between the telephone company central office and a CENTREX system.

Uniform Service Order Code (USOC) - a computer code used by the telephone company to identify various items of service or equipment. Commonly used codes are:

BZZ - buzzer

CUT - manual exclusion

DA9 - dial intercom (first nine stations)

DAD - dial intercom (each additional station)

EXB - extension bell

EXT - extension station

FJZ - signal and buzzer
KFM - light indicator for each key station line
KLL - automatic exclusion
KX1 - one-button set
KX2 - six-button set
KX3 - twelve, eighteen, or thirty button Call
Director
NRX - line access or treatment
RXR - basic CENTREX line
SBV - busy light indicator for each key station line
SP3 - speaker set

Wide Area Telephone Service (WATS) - a calling service provided by the telephone company permitting access to a specific zone in the U. S. for a flat rate.

APPENDIX B

Proposal for the Future Telephone Management Organization at the Naval Postgraduate School

At the present time the Naval Telecommunications Center Monterey (NTCC) is a tenant activity of the Naval Postgraduate School and is under the direct responsibility of the Commanding Officer, Naval Communications Station San Francisco. The Officer in Charge acts as Communications Officer for NPGS under the Director of Military Operations and Logistics. The Officer in Charge's responsibilities include providing communications assistance to all Naval activities in the area and maintaining liaison with Naval activities for any special projects or new requirements involving communications [NPGSINST 5000.1G, 1971].

In accordance with the proposed Navy-wide telephone management realignment, Figure 11 graphically depicts a possible realignment for the Naval Postgraduate School. The Officer in Charge of the NTCC, Monterey, while continuing to report directly to CO, NCS SFRAN, will assume all responsibilities for telephone system and service management now assigned to the Public Works Officer. The Officer in Charge will act as Telephone Officer for the NPGS as an inherent part of his duties as Communications Officer. He shall assume the following specific responsibilities:

1. Operate and maintain all telephone systems and services.

2. Act as liaison officer for telephone matters with other Naval commands and government agencies.

3. Negotiate, prepare, and execute orders for local telephone service and facilities as directed.

4. Maintain an accurate inventory of telephone resources.

5. Conduct invoice reviews and submit reports including budgets and financial accounts, as required.

In order to maintain continuity over the long term and to provide the necessary expertise, a highly trained and knowledgeable civilian Telephone Coordinator shall be assigned to report to the Officer in Charge. This individual shall be responsible for the day-to-day operation and maintenance of the telephone system and services under the Officer in Charge, and shall carry out the above responsibilities as directed. He shall serve as an advisor to the command for the configuration, control, and overall management of the system. His assigned duties should be defined as broadly as possible, and he should not be overly encumbered by the military chain of command. He shall serve as the central focal point for the overall management of the installed telephone network as a subset of the Navy's telecommunications system. Sufficient staff shall be assigned to provide efficient and effective administration.

The Officer in Charge shall maintain close liaison with the Director of Operations and Logistics concerning all local telephone matters in order to effectively and efficiently

meet local telephone service requirements. Fiscal guidelines imposed by CO, NCS, SFRAN, along with operating standards promulgated by COMNAVTELCOM, should be the primary constraints on these services.

The Public Works Department of the NPGS will continue to provide maintenance and engineering support as specified by COMNAVFACENGCOM.

The proposed Department of the Navy realignment policy of treating telephones as a component of the telecommunications system vice as a utility, at the national as well as the local level, serves to provide uniform management of telecommunication, on an end-to-end basis, within the Department of Defense. This policy allows for centralized coordination of telephone/AUTOVON matters and would allow for greater responsiveness to DCA operational direction and management control. Additionally, true visibility of all telecommunications administrative and fiscal resources is obtained.

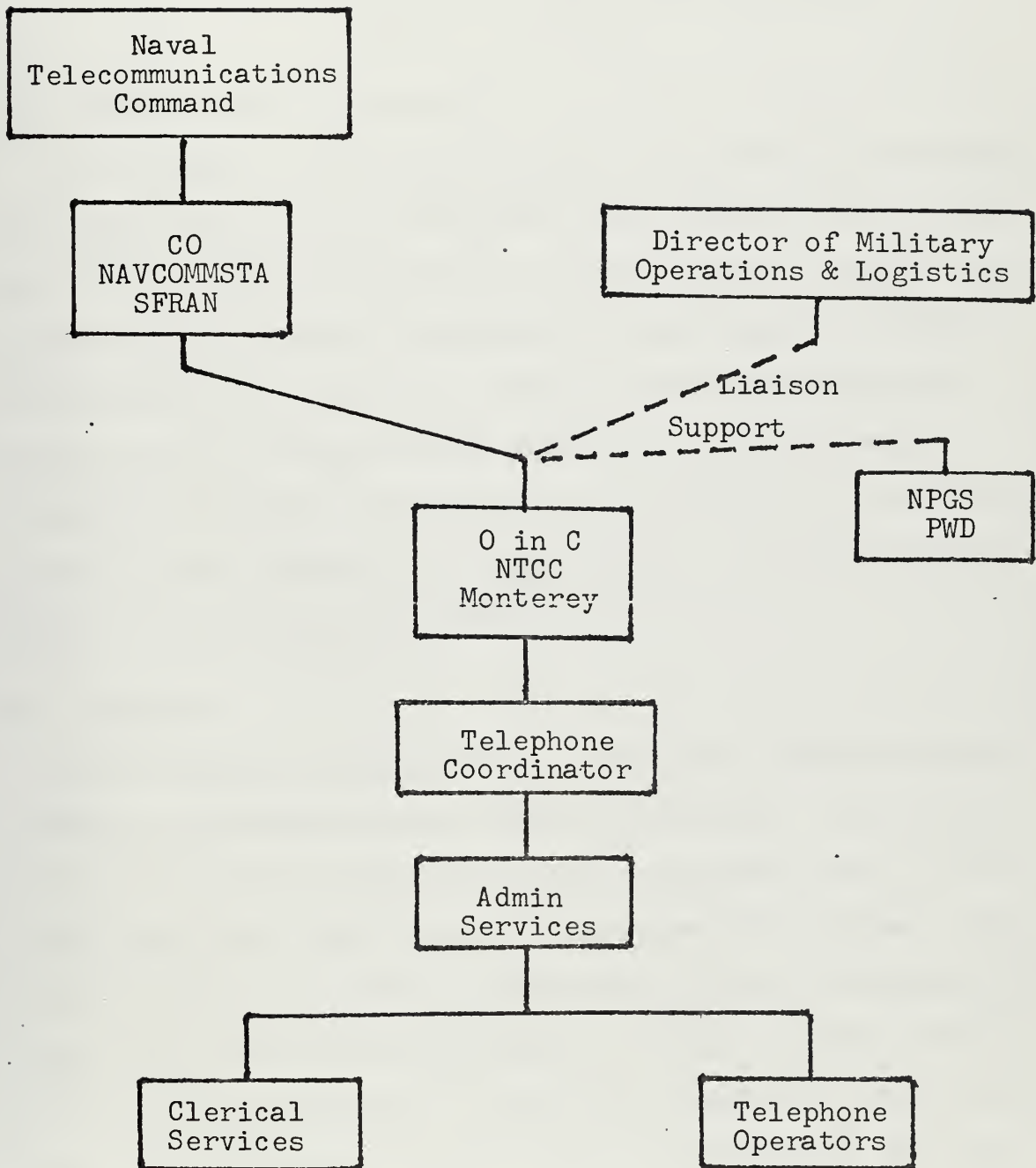


Figure 11. Telephone Management Organization (Proposed).

APPENDIX C

Standards and Guidelines for Local Administrative Telephone Management

A. PURPOSE AND APPLICABILITY

The purpose of this instruction is to establish standards and guidelines for the management and utilization of equipment and facilities associated with the administrative telephone system under the cognizance of the Commanding Officer. This instruction indirectly refers to and implements for this activity the applicable provisions of the Federal Property Management Regulations Section 101.35. Any deviation from the standards contained herein must have prior approval of the Commanding Officer.

B. PLANNING

The telephone administrative organization shall maintain a Master Telecommunications Development Plan. The purpose of the Plan is to support the base development plan in all areas which may impact the telecommunications system. It will serve to centralize the planning effort coordination and requirement determination essential to the logical, concise, and efficient management of the base telecommunications system. The Plan should include, but is not limited to, the following specific areas:

1. The latest traffic surveys and evaluation studies including all recommendations;

2. A current listing of all installed equipment and other resources available;

3. The complete status of all construction projects, planned or in progress, which will impact on the telecommunications system;

4. Complete system drawings including wiring diagrams, trunking diagrams, key system worksheets, cable systems, etc.;

5. Copies of current contracts for obtaining service, line, trunks, etc.;

6. Copies of all current agreements for providing service or facilities to commercial businesses;

7. Tariff regulations;

8. Emergency telecommunications provisions and procedures; and

9. Future anticipated requirements for intervals of one, three, and five years based on past trends, normal growth, reorganizations, unit relocations, and changes in mission or method of operation.

C. SYSTEMS EVALUATION

A local systems evaluation will be conducted annually. This review, utilizing established evaluation techniques, will be directed toward improving overall cost-effectiveness. Emphasis shall be placed on long-distance traffic analysis and a thorough review of user requirements. Key system configurations, with their associated extra features, should be subject to careful scrutiny.

A detailed report of the results of the evaluation, including recommendations for follow-up action, shall be promptly submitted to the Commanding Officer.

D. INVENTORY

An accurate inventory of all installed equipment shall be maintained. The inventory shall be updated monthly to reflect changes resulting from CSAs.

On a quarterly basis, the inventory will be compared against telephone company Green Sheets. Any variation in quantity or type of equipment installed shall be noted and appropriate investigation and/or corrective action initiated.

E. TELEPHONE INSTRUMENTS

1. Conventional Instruments

a. Telephones shall be provided only for those employees whose duties require them to place and receive official telephone calls.

b. The ratio of telephone instruments to personnel is normally to be a maximum of eight instruments to ten personnel.

c. One telephone shall serve the needs of two or more persons at adjacent desks whose call volume is sufficiently low that sharing would not affect operations directly.

d. In large open office spaces where routine operations are performed and only occasional official

calls are made or received, each instrument shall be shared by as many persons as feasible.

e. One instrument in an office occupied by only one person shall be standard practice.

f. Within office spaces using more than three lines, it shall be the normal practice to utilize six-button key telephones. Within spaces using three lines or less, single line or two line instruments shall be standard.

2. Key Stations

Key stations shall be provided only where traffic volume and work methods require an instrument to have access to more than one line and at secretarial locations to permit answering of calls for several persons on more than one line. When secretarial service is provided for a group of persons engaged in similar work, individual call volume often can be channeled through a lesser number of rotary lines. The need for larger than the six-button instrument can often be eliminated by limiting the number of lines appearing on each station or by providing external buttons for in-office signaling. The single button instrument which provides access to two lines without holding or illumination features should be utilized whenever possible, using different bell tones or locations to indicate which line is being called.

3. Call Directors

Where a six-button key station will not provide a sufficient number of lines, key stations of larger capacity

may be used. Call Directors shall be used only where centralized answering service by secretaries or receptionists is provided or required. Signal buttons should not be located in a Call Director because of the cost of the signal button increases considerably when provided internally in this equipment. Neither should the internal signal button requirement be used as justification for a Call Director.

4. Automatic Dial

Automatic dialing equipment may be provided only when the average number of calls placed per day exceeds 50 and when the same numbers are called on a repetitive basis.

5. Touch-tone Instruments

Touch-tone instruments are prohibited unless they are provided at no additional costs, required for a physically handicapped employee to perform his official duties and the instrument can be substituted for regular service without modification to the switch system, or used only as a data input device.

6. Color Instruments

Color instruments may be installed only where required to identify emergency or security telephone lines or where they can be provided at no additional cost.

7. Speakerphones

Speakerphones may be provided only in those offices where there is frequent need for group participation in telephone conversations or where hands-free answering is essential.

8. Paging Devices

Automatic call devices such as tone or voice pagers may be provided for use in connection with emergency activities and in unusual operating situations.

9. Answering Devices

Automatic answering devices should be installed only where there is a demonstrated need to receive messages when the telephone is normally unattended.

10. Recording and Listening Devices

a. Administrative Telephone Systems with Trunks to a Commercial Telephone Exchange

(1) Recording devices may be used when there is a specific requirement for exact reproduction.

(2) No conversation will be recorded without prior consent of the other party or parties to the conversation.

(3) When a recorder is used, it will be equipped with a tone warning device which automatically produces a distinct warning tone repeated at intervals of approximately fifteen seconds.

b. Intercommunication Systems not Associated with a above and Leased Lines under Complete DOD Control.

(1) Recording devices may be used on such systems and lines, when no connection to commercial trunks is involved, under the following conditions:

(a) Requirement for accuracy exists.

(b) Provision of information on data for future reference is necessary.

(c) Stenographic personnel are not readily available.

(2) Tone warning devices are not required when a recording equipment is used in connection with the foregoing.

11. Hold Buttons

Hold buttons should be installed only where there is a valid need. They should not automatically be provided on all key system instruments that have more than one line.

12. Line Illumination

Line illumination may be provided where the location or quantity of lines or instruments preclude discernment of distinctive audible signals or incoming calls or visual observation of line availability on outgoing calls. Illumination normally is not required on installations of only two lines appearing on a few telephones located in the same room. When only visual identification of incoming calls is required, the flashing "line lamp" illumination should suffice. In situations where it is necessary to visually identify a busy line, the steady "busy lamp" illumination may be required. If both types of visual indication are required, then both the line and "busy lamp" illumination may be required.

13. Wink-hold

The use of "wink-hold" illumination is prohibited where any additional costs are involved, unless special requirements justify the additional cost.

14. Exclusion Keys

Exclusion or cut-off keys, either manual or selective, should be installed only where a demonstrated need for private conversations exists.

15. Signaling Devices

Extraordinary signaling devices, such as buzzers or signals, are prohibited except where used in lieu of illumination to differentiate between telephone instruments.

16. Instrument Variations

Panel, Princess, Trimline, or other instrument variations will not normally be provided or installed where additional cost is incurred. At locations where Class B service is provided, special instrument requests may be honored by passing the additional charge on to the customer.

F. TELEPHONE LINES

1. Primary and Secondary Lines

The number of lines available for pickup on a given instrument should be sufficient for, but not in excess of, the number essential for conduct of the assigned function. Call volume, rather than individual preference or grade level, should determine the number of lines provided. An occasional busy line is not justification for an additional line. A

primary line is considered to be capable of handling 20 average-length calls made or received each day.

A secondary line is that supplied to increase the call handling capability of a given office function. When secondary lines are required, they shall be placed in rotary hunt with the primary line. The use of rotary lines provides a considerable increase in the incoming call handling capability of a group of lines over a similar number of individual non-rotary lines. Extension lines should be provided where required.

2. Number of Lines

The ratio of lines to number of personnel in an office is established as one line to three personnel in non-rotary configuration and one line to four personnel using rotary hunt, as a maximum.

3. Individual Business Lines

These lines may be provided only when the user makes and receives numerous official calls which are administratively confidential in nature and cost is secondary to privacy. They shall not be provided as a means of bypassing the base telephone system without special justification and prior approval.

4. Intercommunication Lines

a. Unless provided as an integral part of a key system (36 stations maximum), intercom systems which are separate and parallel to the CENTREX system shall not be provided

in lieu of manual signal buttons and buzzers and/or intercom lines unless economic or special advantages justify their use.

b. Intercommunicating lines shall be provided only when necessary for the distribution of incoming calls to a group of stations sharing the same lines or between points with an extremely high volume of traffic.

Voice telephone intercommunication may be used only where signal buttons and buzzers are incapable of passing adequate information for call distribution.

5. Automatic Ringing Private Lines

Automatic ringing private lines (hot lines) may be installed only where, on an emergency basis, immediate uninterrupted service is essential (for example: fire station, crash crew, or guard facility).

G. AUTOVON

1. Voice Access

a. AUTOVON calls shall be limited to those necessary for the transaction of official business or other essential matters that require timely handling which cannot be handled effectively by other means. Personnel and/or unofficial calls must not be initiated into AUTOVON at any time.

b. Class A (official) telephones only are authorized access to AUTOVON for initiating calls.

c. Incoming calls may be connected to Class B or C telephones only with permission of the Commanding Officer.

d. On a not-to-interfere basis, incoming calls may be extended off-net only if the calls are of an official nature and no additional charge is incurred.

e. Routine precedence calls will not normally be handled through the station operator. Users placing calls through the operator will be required to furnish the following data: verification that the call is official; calling party's name, rank or grade; organization; location and name of party being called; and the precedence of the call.

f. Calls of all AUTOVON users are subject to pre-emption by calls of a higher precedence.

g. The AUTOVON system must be used over commercial service in all applicable situations. Where not applicable, such as calls to a non-DOD activity, consideration should be given to utilizing AUTOVON off-net procedures.

2. Data Access

a. Certain access lines may be conditioned to meet subscriber requirements for alternate voice/data service.

b. Data record service in AUTOVON should neither exceed a continuous transmission time of 15 minutes nor a total transmission time of one hour during normal business hours on any one day.

c. Data devices used over AUTOVON lines will be equipped with an automatic disconnect feature which will free the circuit after the device is inactive for a period of one minute.

H. WATS, FTS, AND FX SERVICE

Based on the results of traffic and economic analyses, WATS, FTS, and FX should be considered as alternative to direct distance dialing. The various methods of long-distance dialing should be used collectively to obtain maximum long-distance service at minimum expense.

All outgoing WATS and FX calls must be placed through the base telephone switchboard operator. FTS calls, when provided for, may be made direct.

I. LONG-DISTANCE TELEPHONE CALLS

1. The following principles apply concerning long-distance toll calls:

a. Long-distance toll calls, and length thereof, must be held to a minimum commensurate with efficient operations to preclude unnecessary expense.

b. Toll calls should not be authorized except in situations where the matter to be discussed is urgent and other less expensive means of communications such as letters, messages, and leased lines including AUTOVON will not suffice.

c. Official telephones should not be used for unofficial toll calling. Public telephones should be used whenever possible for such calls. Transfer of charges to a private line should be avoided because of the added administrative burden.

d. Tolls incurred should not be reversed unless prior arrangements have been made for the receiving end to accept them. Personnel absent from the station on duty may call collect to the cognizant department head when situations or conditions are encountered which require immediate consultation with higher authority.

e. "Person to person" calls may be made only when it is known that the person is readily available and will have the information required. Otherwise, use "station to station" calls to take advantage of the reduced rates.

f. Give considerable thought to the substance of the proposed conversation before the call is placed. Assemble noted and reference material in advance. Stick to the point of the conversation and be brief.

2. Department heads are responsible for all official and unofficial toll calls made from assigned telephone stations and are authorized to approve toll calls. For each toll call, a Toll Call Record (NAVS0 2305/2) must be completed by the calling party and signed by the department head. These forms must be retained within the department for later verification of toll charges. Additionally, the approving authority is responsible for determining the necessity of the toll call and that less expensive means of communication have been considered and determined to be inadequate.

J. ORDERING OF TELEPHONE SERVICE

Requests for telephone installations, changes, or discontinuance shall be submitted by work request via the department head. Orders shall be submitted as far as possible in advance of the date service is requested. Normal processing time for a local work order shall be two weeks from date of request.

Each installation or change request shall be thoroughly reviewed by the telephone coordinator to ensure that the requested service economically and effectively meets the user's requirements and is in conformance with existing telephone policies.

Installations or changes other than those called for on the order shall not be made without amending the existing order or preparing a new order.

Only authorized employees of the telephone company or of the activity providing telephone service shall be allowed to install or change telecommunications equipment. Command personnel will not direct the actions of telephone employees when they are engaged in the installation of telephone equipment except for rendering assistance in interpreting installation location details.

K. PRECEDENCE SYSTEM

1. For DOD-leased Lines (AUTOVON)

The National Communications System (NCS) Voice Precedence System is directed for use by all authorized uses of

the voice communications facilities of the DOD. Each user should consider whether a call requires special precedence and exercise care not to request or utilize one higher than the circumstances require. The precedence indicators listed below specify the relative order in which telephone calls should be handled based on the importance (content) of the call.

a. Flash - reserved generally for telephone calls pertaining to:

- (1) Command and control of military forces essential to defense and retaliation;
- (2) Critical intelligence essential to national survival;
- (3) Conduct of diplomatic negotiations critical to the arresting or limiting of hostilities;
- (4) Dissemination of critical civic alert information essential to national survival;
- (5) Continuity of Federal Government functions essential to national survival;
- (6) Fulfillment of critical U.S. internal security functions essential to national survival;
- (7) Catastrophic events of national or international significance.

b. Immediate - reserved generally for telephone calls pertaining to:

- (1) Situations which gravely affect the security of national and allied forces;

- (2) Reconstruction of forces in a post-attack period;
- (3) Intelligence essential to national security;
- (4) Conduct of diplomatic negotiations to reduce or limit the threat of war;
- (5) Implementation of Federal Government actions essential to national survival;
- (6) Situations which gravely affect the internal security of the U.S.;
- (7) Civil Defense actions concerning direction of our population and their survival;
- (8) Disasters or events of extensive seriousness having an immediate and detrimental effect on the welfare of the population;
- (9) Vital information having an immediate effect on aircraft, spacecraft, or missile operations.

c. Priority - reserved generally for telephone calls requiring expeditious action by called parties and/or furnishing essential information for the conduct of government operations.

d. Routine - applies to those official government communications which require rapid transmission by telephonic means but do not require preferential handling.

2. For long distance (toll calls)

This precedence system, established by the Federal Communications Commission is directed for preferred handling

of telephone service essential to the national defense, security, or public safety in the event of national emergency or serious national disaster.

a. Group 1 (Priority 1 Emergency) - for matters concerning:

(1) Immediate dangers due to the presence of the enemy;

(2) Intelligence reports on matters leading to enemy attack;

(3) Urgent calls to or from the U.S. Armed Forces and their allies;

(4) Proclamations of Civil Defense emergency.

b. Group 2 (Priority 2 Emergency) - for matters concerning:

(1) Initial reports of damage due to enemy action;

(2) Civil Defense activities immediately subsequent to and resulting from enemy attack;

(3) Calls that require immediate completion to or from the U.S. Armed Forces and their allies;

(4) Natural disaster of extreme seriousness and widespread damage.

c. Group 3 (Priority 3 Emergency) - for matters concerning:

(1) Civil Defense or the public safety;

(2) Important governmental functions;

- (3) Supply and movement of food;
- (4) Maintenance of essential public services;
- (5) Production or procurement of essential material and supplies;
- (6) Calls that require rapid completion to or from the U.S. Armed Forces and their allies.

L. SECURITY AND MONITORING OF CONVERSATIONS

Telephone systems do not meet the qualifications for transmission of classified information. Classified matter may never be discussed over any administrative telephone system that is not designed for such purposes (i.e., cryptographically covered).

Telephone systems on military installations are provided for the transmission of official government information only and are subject to security monitoring and telephone communications management monitoring at all times.

M. STATION TELEPHONE DIRECTORIES

Telephone directories will be corrected and revised by the telephone administrative department as necessary to keep listings current. Directories normally should not be issued more than twice a year unless unusual circumstances arise, such as a mass move of personnel or offices. As the requirement for additions or deletions occur, interim instructions should be made by addendum until a new directory is published.

Distribution of telephone directories should be made to telephone system users (including Class B subscribers) on or

adjacent to the installation and to off-post activities as desirable for official purposes. Basis of distribution will be one copy per instrument. Distribution to non-military activities which may use the information contained within for private gain is prohibited.

APPENDIX D

Computer Program for Telephone Equipment Inventory

A. PROGRAM SYNOPSIS

This computer program, written in COBOL language, is designed to produce a telephone equipment listing for a local telephone management organization. The output listing is divided into three parts in order to provide a readily useable management tool. The first part lists all information contained in the input record card and is ordered sequentially by department code and building/room location within each department code. The second part gives identical information as the first part except the listing is ordered sequentially by building/room number. The third part provides a sequential listing of telephone numbers with their associated department code and location.

Through the use of this inventory, the manager can review the configuration of each telephone instrument, its location by department and building/room, and its rental cost. The number of instruments per department and room is readily apparent. Additionally, a complete listing of telephone numbers is provided.

The inventory listing must be based on a thorough and accurate physical inventory of all installed telephone stations and should be updated as changes occur.

B. INPUT RECORD DESCRIPTION

The input record, designated in the program by DETAIL-IN, is a standard Hollerith punched card. Card input was chosen over magnetic tape file to allow ease of update by clerical personnel. Each card represents the configuration of a single telephone station. The following information is contained in the input record:

<u>Name</u>	<u>Card Column</u>	<u>Contents</u>
Department Code	1 - 4	4-digit administrative organization department code.
Building	7 - 9	Building number
Room	11 - 14	Room number within the building.
USOC-Code	17 - 19	3-digit telephone company code.
KS-NR	23 - 24	Local key station number.
Extra Features	27 - 41	3-digit codes for extra features attached to the station.
Access Numbers	45 - 68	The first number is the telephone number of the station. Subsequent numbers are access numbers on key stations.
Configuration Code	71 - 72	The type of line configuration.
Cost	75 - 80	The total rental cost of the station.

C. LISTING OF JCL USED

```
// EXEC COBUCLG,REGION.GO=250K
//COB.SYSIN DD *
//GO.SORTPR DD SYSOUT=A
//GO.SORTLIB DD DSN=SYS1.SORTLIB,DISP=SHR
//GO.SORTWK01 DD UNIT=SYSDA,SPACE=(TRK,(5,1),,CONTIG)
//GO.SORTWK02 DD UNIT=SYSDA,SPACE=(TRK,(5,1),,CONTIG)
//GO.SORTWK03 DD UNIT=SYSDA,SPACE=(TRK,(5,1),,CONTIG)
//GO.SORTWK04 DD UNIT=SYSDA,SPACE=(TRK,(5,1),,CONTIG)
//GO.SORTWK05 DD UNIT=SYSDA,SPACE=(TRK,(5,1),,CONTIG)
//GO.SORTWK06 DD UNIT=SYSDA,SPACE=(TRK,(5,1),,CONTIG)
//GO.PRINT DD SYSOUT=A
//GO.TEMP DD UNIT=2314,VOL=SER=SPOOL1,DSN=S2438.INVREC,
//          DCB=(RECFM=FB,LRECL=80,BLKSIZE=7280),
//          DISP=(NEW,DELETE),SPACE=(CYL,(1,1))
//GO.CARDIN DD *,DCB=BLKSIZE=80
```


D. SAMPLE OUTPUT

INVENTORY RECORD

DATE: 03/11/75

DEPT	BLDG	LOCATION	ROOM	USOC	KS	EXTRA	FEATURES	ACCESS	CONFIG.	COST(\$)
0005	220	0000	KX2	81	KFM	FJZ	CUT	2891 2533 2534	S4	14.55
0005	330	102A	RXR					2042	S4	7.70
0023	232	0308	RXR					2121	S4	7.70
0036	224	0205	EXT					2217	S4	3.75
0041	235	254A	RXR					2120	S1	7.70
0042	206	0018	KX2	79	KFM	DAD		2036	S4	14.55
0042	232	329A	KX2	30	KFM	DA9		2807	S4	12.90
0061	232	0612	KX2	15	KFM	DA9		2346	S4	20.15
0306	235	0251	RXR					2129	S1	7.70
0436	330	0114	KX2	22	KFM	KGM		2391 2392	S4	13.20

LOCATION	BLDG ROOM	DEPT CODE	USOC CODE	KS NR	EXTRA FEATURES	ACCESS NUMBERS	CONFIG CODE	COST (\$)
206	0018	0042	KX2	79	KFM DAD	2036	S4	14.55
220	0000	0005	KX2	81	KFM FJZ CUT	2891	S4	14.55
224	0205	0036	EXT			2217	S4	3.75
232	0308	0023	RXR	15		2121	S4	7.70
232	0612	0061	KX2	30	KFM DA9	2346	S4	20.15
232	329A	0042	KX2			2807	S4	12.90
235	0251	0306	RXR			2129	S1	7.70
235	254A	0041	RXR	22	KFM KGM	2120	S1	7.70
330	0114	0436	KX2			2391	S4	13.20
330	102A	0005	RXR			2042	S4	7.70
						2347		
						2348		
						2658		
						2450		
						2378		
						2467		

STATION NUMBER	DEPT CODE	BLDG ROOM	LOCATION
2036	0042	206	0018
2042	0005	330	102A
2120	0041	235	254A
2129	0023	232	0308
2217	0306	235	0251
2346	0036	224	0205
2391	0061	232	0612
2807	0436	330	0114
2891	0042	232	329A
	0005	220	0000

E. PROGRAM LISTING

```

IDENTIFICATION DIVISION.
PROGRAM-ID. INVENTORY-RECORD.
ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
SOURCE-COMPUTER. IBM-360-67.
OBJECT-COMPUTER. IBM-360-67.
SPECIAL-NAMES.
CO1 IS PAGE-TOP.
INPUT-OUTPUT SECTION.
FILE-CONTROL.
SELECT REPORT-OUT ASSIGN TO UR-S-CARDIN,
SELECT RESERVE NO ALTERNATE AREA.
SELECT TEMP-FILE ASSIGN TO DA-S-TEMPF.
SELECT SD-TEMP-FILE ASSIGN TO DA-S-SORT.

DATA DIVISION.
FILE SECTION.
FD
RECORDING MODE IS F, OMITTED,
LABEL RECORDS ARE 80 CHARACTERS,
RECORD CONTAINS 80 CHARACTERS,
DATA RECORD.
INV-RECD-CODE
05 FILLER
05 BLDG
05 FILLER
05 ROOM
05 FILLER
05 USOC-CODE
05 FILLER
05 KS-NR
05 FILLER
05 EXTRA-FEATURES.
05 EX-1
05 FILLER
05 EX-2
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05 EX-3
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05 ACCESS-NRS.
05 NR-1
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10

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05 FILLER
05 ACCESS-NRS.

05	FILLER
05	CONFIG-CODE
05	FILLER
05	COST

[illegible]

01	05 FILLER	PIC X(21) VALUE SPACES.
	05 COLUMN-HEADING-5.	
	05 FILLER	X.
	05 FILLER	PIC X(47) VALUE SPACES.
	05 FILLER	PIC X(7) VALUE STATION.
	05 FILLER	PIC X(8) VALUE SPACES.
	05 FILLER	PIC X(4) VALUE DEPT.
	05 FILLER	PIC X(10) VALUE SPACES.
	05 FILLER	PIC X(8) VALUE LOCATION.
	05 FILLER	PIC X(48) VALUE SPACES.
01	05 COLUMN-HEADING-6.	
	05 FILLER	X.
	05 FILLER	PIC X(47) VALUE SPACES.
	05 FILLER	PIC X(6) VALUE NUMBER.
	05 FILLER	PIC X(9) VALUE SPACES.
	05 FILLER	PIC X(4) VALUE CODE.
	05 FILLER	PIC X(10) VALUE SPACES.
	05 FILLER	PIC X(4) VALUE BLDG.
	05 FILLER	PIC X VALUE SPACES.
	05 FILLER	PIC X(4) VALUE ROOM.
	05 FILLER	PIC X(47) VALUE SPACES.
01	05 INV-LINE-1.	
	05 FILLER	X.
	05 FILLER	PIC X(28) VALUE SPACES.
	05 DEPT-CODE	PIC X(4) VALUE SPACES.
	05 FILLER	PIC X(3) VALUE SPACES.
	05 BLDG	PIC X(2) VALUE SPACES.
	05 FILLER	PIC X(4) VALUE SPACES.
	05 ROOM	PIC X(2) VALUE SPACES.
	05 FILLER	PIC X(3) VALUE SPACES.
	05 USOC-CODE	PIC X(2) VALUE SPACES.
	05 FILLER	PIC 99 BLANK WHEN ZEROS.
	05 KS-NR	PIC X(2) VALUE SPACES.
	05 FILLER	
	05 EXTRA-FEATURES.	
	10 EX-1	PIC X(3) VALUE SPACES.
	10 FILLER	PIC X(3) VALUE SPACES.
	10 EX-2	PIC X(3) VALUE SPACES.
	10 FILLER	PIC X(3) VALUE SPACES.
	10 EX-3	PIC X(3) VALUE SPACES.
	10 FILLER	PIC X(3) VALUE SPACES.
	10 EX-4	PIC X(2) VALUE SPACES.
	10 FILLER	
05	05 ACCESS-NRS.	
	10 NR-1	PIC 9(4) BLANK WHEN ZEROS.
	10 FILLER	PIC X VALUE SPACES.
	10 NR-2	PIC 9(4) BLANK WHEN ZEROS.
	10 FILLER	PIC X VALUE SPACES.

01	10 NR-3	PIC	9(4)	BLANK WHEN ZEROS.
	10 FILLER	PIC	X	VALUE SPACES.
	10 NR-4	PIC	9(4)	BLANK WHEN ZEROS.
	10 FILLER	PIC	X	VALUE SPACES.
	10 NR-5	PIC	9(4)	BLANK WHEN ZEROS.
	FILLER	PIC	X(3)	VALUE SPACES.
	05 CONFIG-CODE	PIC	X(2)	VALUE SPACES.
	05 FILLER	PIC	X(4)	VALUE SPACES.
	05 COST	PIC	ZZZZ.99.	
	05 FILLER	PIC	X(21)	VALUE SPACES.
01	05 INV-LINE-2.			
	05 FILLER	PIC	X	VALUE SPACES.
	05 FILLER	PIC	X(28)	VALUE SPACES.
	05 BLDG	PIC	X(3)	VALUE SPACES.
	05 FILLER	PIC	X(2)	VALUE SPACES.
	05 ROOM	PIC	X(4)	VALUE SPACES.
	05 FILLER	PIC	XX	VALUE SPACES.
	05 DEPT-CODE	PIC	X(4)	VALUE SPACES.
	05 FILLER	PIC	X(2)	VALUE SPACES.
	05 USOC-CODE	PIC	X(3)	VALUE SPACES.
	05 FILLER	PIC	X(2)	VALUE SPACES.
	05 KS-NR	PIC	99	BLANK WHEN ZEROS.
	05 FILLER	PIC	X(2)	VALUE SPACES.
	05 EXTRA-FEATURES.			
	10 EX-1	PIC	X(3)	VALUE SPACES.
	10 FILLER	PIC	X	VALUE SPACES.
	10 EX-2	PIC	X(3)	VALUE SPACES.
	10 FILLER	PIC	X	VALUE SPACES.
	10 EX-3	PIC	X(3)	VALUE SPACES.
	10 FILLER	PIC	X	VALUE SPACES.
	10 EX-4	PIC	X(3)	VALUE SPACES.
	10 FILLER	PIC	X(2)	VALUE SPACES.
	05 ACCESS-NRS.			
	10 NR-1	PIC	9(4)	BLANK WHEN ZEROS.
	10 FILLER	PIC	X	VALUE SPACES.
	10 NR-2	PIC	9(4)	BLANK WHEN ZEROS.
	10 FILLER	PIC	X	VALUE SPACES.
	10 NR-3	PIC	9(4)	BLANK WHEN ZEROS.
	10 FILLER	PIC	X	VALUE SPACES.
	10 NR-4	PIC	9(4)	BLANK WHEN ZEROS.
	10 FILLER	PIC	X	VALUE SPACES.
	10 NR-5	PIC	9(4)	BLANK WHEN ZEROS.
	10 FILLER	PIC	9(4)	BLANK WHEN ZEROS.
	05 CONFIG-CODE	PIC	X(3)	VALUE SPACES.
	05 FILLER	PIC	X(2)	VALUE SPACES.
	05 COST	PIC	ZZZZ.99.	
	05 FILLER	PIC	X(4)	VALUE SPACES.
01	05 INV-LINE-3.			


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05 FILLER
05 FILLER
05 ACCESS-NRS.
05 10 NR-1
05 FILLER
05 DEPT-CODE
05 FILLER
05 BLDG
05 FILLER
05 ROOM
05 FILLER
05 FILLER
PROCEDURE DIVISION.
SET-UP.
OPEN OUTPUT REPORT-OUT.
MOVE CURRENT-DATE TO HB-DATE.

SORT-1.
SORT SD-TEMP-FILE
ASCENDING KEY SDEPT-CODE, SBLDG, SROOM
INPUT PROCEDURE READ-1,
GIVING TEMP-FILE.
GO TO W-1-1.

READ-1 SECTION.
R-1-1. OPEN INPUT DETAIL-IN.
R-1-2. READ DETAIL-IN AT END GO TO R-1-FINAL.
R-1-3. MOVE INV-RECORD TO SORT-INV.
RELEASE SORT-INV.
GO TO R-1-2.
R-1-FINAL.
WRITE PRINTER FROM HEADER-A AFTER ADVANCING PAGE-TOP.
WRITE PRINTER FROM HEADER-B AFTER 2. AFTER 3.
WRITE PRINTER FROM COLUMN-HEADING-1 AFTER 1.
WRITE PRINTER FROM COLUMN-HEADING-2 AFTER 1.
WRITE PRINTER FROM HEADER-C AFTER 1.
CLOSE DETAIL-IN.
R-1-END.
EXIT.

WRITE-1 SECTION.
W-1-1. OPEN INPUT TEMP-FILE.
W-1-2. READ TEMP-FILE AT END GO TO W-1-FINAL.
MOVE CORRESPONDING TEMP-REC TO INV-LINE-1.
WRITE PRINTER FROM INV-LINE-1 AFTER 1.
W-1-3. GO TO W-1-2.

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PIC X(48) VALUE SPACES.
PIC X(4).
PIC X(10) VALUE SPACES.
PIC X(4).
PIC X(10) VALUE SPACES.
PIC X(3).
PIC XX VALUE SPACES.
PIC X(4).
PIC X(47) VALUE SPACES.

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W-1-FINAL. TEMP-FILE, REPORT-OUT.
SORT-2.
  SORT SD-TEMP-FILE
  ASCENDING KEY SBLDG, SROOM, SDEPT-CODE
  INPUT PROCEDURE READ-2
  GIVING TEMP-FILE.
GO TO W-2-1.
READ-2 SECTION.
R-2-0.
  OPEN INPUT DETAIL-IN.
  OPEN OUTPUT REPORT-OUT.
R-2-1.
  READ DETAIL-IN AT END GO TO R-2-FINAL.
R-2-2.
  MOVE INV-RECORD TO SORT-INV.
  RELEASE SORT-INV.
  GO TO R-2-1.
R-2-FINAL.
  WRITE PRINTER FROM COLUMN-HEADING-3 AFTER PAGE-TOP.
  WRITE PRINTER FROM COLUMN-HEADING-4 AFTER 1.
  WRITE PRINTER FROM HEADER-C AFTER 1.
  CLOSE DETAIL-IN.
R-2-END.
EXIT SECTION.
WRITE-2.
W-2-1.
  OPEN INPUT TEMP-FILE.
W-2-2.
  READ TEMP-FILE AT END GO TO W-2-FINAL.
  MOVE CORRESPONDING TEMP-REC TO INV-LINE-2.
  WRITE PRINTER FROM INV-LINE-2 AFTER 1.
W-2-3.
  GO TO W-2-2.
W-2-FINAL.
  CLOSE TEMP-FILE, REPORT-OUT.
SORT-3.
  SORT SD-TEMP-FILE
  ASCENDING KEY SNR-1
  INPUT PROCEDURE READ-3
  GIVING TEMP-FILE.
GO TO W-3-1.
READ-3 SECTION.
R-3-0.
  OPEN INPUT DETAIL-IN.
  OPEN OUTPUT REPORT-OUT.
R-3-1.
  READ DETAIL-IN AT END GO TO R-3-FINAL.

```


R-3-2. MOVE INV-RECORD TO SORT-INV.
RELEASE SORT-INV.
GO TO R-3-1.
R-3-FINAL. DETAIL-IN.
CLOSE PRINTER FROM COLUMN-HEADING-5 AFTER PAGE-TOP.
WRITE PRINTER FROM COLUMN-HEADING-6 AFTER 1.
WRITE PRINTER FROM HEADER-D AFTER 1.
R-3-END.
EXIT.
WRITE-3 SECTION.
W-3-1. OPEN INPUT TEMP-FILE.
W-3-2. READ TEMP-FILE AT END GO TO W-3-FINAL.
MOVE CORRESPONDING TEMP-REC TO INV-LINE-3.
WRITE PRINTER FROM INV-LINE-3 AFTER 1.
W-3-3. GO TO W-3-2.
W-3-FINAL. PRINTER FROM HEADER-C AFTER PAGE-TOP.
CLOSE TEMP-FILE, REPORT-OUT.
STOP RUN.

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